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THOSE who have had an extensive experience with superheaters on stationary boilers using temperatures up to 660 and 700 deg. F. have expressed a decided opinion that 600 deg. F. is the limit at which the advantages of superheating can be obtained without excessive cost of maintenance due to high temperatures. It is known that between 500 and 600 deg. F. cast iron enlarges its volume and increases in weight. The carbon rearranges itself and experiments show that after one or two years' exposure to high temperatures the volume has increased 5 per cent and the weight 7 per cent. Copper and tin alloys are also affected by highly superheated steam and cast steel is better than cast iron or bronze for boiler fittings, piping and machinery where bearing surfaces will permit.

THE drop testing machine is probably the most useful device employed by railways in obtaining information as to the quality of iron and steel products which they buy in such large quantities. It was designed originally for testing axles, and its application has extended to the testing of rails, couplers, draft gears, wheels, and to such larger details as locomotive frames. In the report of the committee on Steel Tires, the drop test is for the first time officially recognized as an important element in a specification for such material. This will add to the expense for tires, as every drop test destroys a tire and it is paid for by the railway. The burden of this charge need not be large, as it should not be necessary to drop test a tire from every heat at a works where the process of steel manufacture is as uniform as it should be. This method of testing deals with the complete and finished structure and is therefore an improvement over the previous methods used in this country which deals only with tensile specimens taken from a small test ingot and chemical analysis from the same small ingot. It might be employed at first on a single tire from one order or for one lot of locomotives. The effect on the effort of the manufacturers would be almost as great as if a large number of tires were destroyed at considerable expense. The drop test for tires has been used in European countries for many years and it is surprising that it has not been adopted here before. As a new and radical departure from previous methods it would have been interesting and instructive if the committee had given some account of the experience gained by drop tests of tires in foreign countries with examples showing the basis of the requirements which they now recommend.

THE discussion of the report on the Contour of Tires for Engine and Tender Trucks indicated that there is a reluctance on the part of quite a number of roads to adopt either the old standard or the new one proposed. There has been a gradual modification of opinion as to the necessary height of the flange of steel tires to secure safety from derailment. With the general improvement of the track surface it has been possible to reduce the height to 1⅛ in. for the drivers of road engines, and there was little, if any, opposition to the proposed standard height of 1 in. for engine and tender truck tires. In fact, some lines have used a height as small as ⅞ in. for switching engines, and it is possible that a flange 1 in. deep could be safely used for the driving tires of slow speed freight engines. The reduction in the height of flange will effect an important economy in the expense, as there will be less steel wasted from the tread in restoring a full flange to worn tires. The principal feature of tire contour about which there is the most disagreement is the standard taper which some regard as too sharp, as it requires a greater amount to be turned from the tread of worn tires, and some have the idea that it increases the eccentric load on the rail enough to break down the head. This latter view has been attacked by competent authority, and the advocates of a cylindric tread for tires will not find any strong support for their theory. Other lines have carried the standard taper clear to the rim with a heavy champfer at the edges. This contour takes less time for turning and there is an apparent saving in the amount of steel turned off. The objection to a flat taper on the cylindric tread is that the wheels tend to run to one rail or the other, and flange wear is increased and so also is track resistance. Probably there will always be some departure from any standard tire contour for the reasons here given, and some latitude should be allowed for this for tires used in the less important services. It is best, however, to have a standard for the faster road engines, and that which has been recommended by the committee should be adopted with this in view.

IT is unfortunate that all the members of the Master Mechanics' Association cannot have an opportunity to see the moving pictures exhibited by D. C. Buell at the Railway Fuel Association convention in Chicago last month. These pictures demonstrated a method of instructing firemen in proper firing practice and by giving visible evidence of the effect of incorrect methods, impressed the lesson far more effectively than is possible with text books, lectures or even personal example on the locomotive. Those observing this demonstration could not avoid having a mental picture of the fireman in the act whenever they observed the effect of wrong practice. It would be difficult to prevent a thought of the pile of coal on the platform, shown in one picture, whenever a locomotive is seen with the safety valves blowing or of the fireman "baling" in the fuel as fast as he could when continuous black smoke is seen rolling out of the locomotive stack. There was no doubt in the minds of those seeing the pictures that this new scheme will prove to be the most powerful agent yet discovered for instructing men of the class and age of the general run of new firemen. Proper firing is not the only lesson that can be taught by this means. It is applicable to any kind of work where the movements, action or methods of the workman are the influencing factor. Apprentices can be taught shop work, trackmen how to properly tamp and spike, trainmen and yardmen how to handle cars, etc. New methods or machines of any kind can be demonstrated more effectively than in actual practice as the films can be run through many times and can be operated very slowly, permitting every detail to be thoroughly studied. In fact, a moment's study will bring to mind almost numberless ways in which the idea can be applied. Conventions of this kind are largely depended upon to bring out the latest and best practices in the field and it is hoped that next year, this new idea can be illustrated to the members by either Mr. Buell or some one who takes it up in the meantime.

THE official registration of this year's M. C. B. and M. M. conventions up to late yesterday afternoon, compared with the full registration from 1908 to 1911, is shown by the following table:

	1908	1909	1910	1911	1912
M. C. B. & M. M. members..	504	523	530	552	543
Special guests	530	723	732	820	629
Railway ladies	595	618	632	690	408
Supply ladies	254	272	356	385	246
Supply men 1,177	1,362	1,526	1,653	1,486
Complimentary			40	47	49
Total 3,060	3,498	3,816	4,147	3,361

The figures contain no duplication of names. That is, those persons who registered as members or guests of both railway associations have in every case been counted but once; so that the table represents the actual number of persons who registered from the opening day until late Tuesday afternoon. It will be seen that while there was an apparent falling off this year as compared with June last of 786 persons, but nine were railway men and 191 special guests of either the M. C. B. or the M. M. association. Of the 191 special guests, it is hard to say what proportion were railway men; but not all were railway men. As a matter of fact, it is pretty well agreed that more, rather than less, railway men attended this year's conventions. The discrepancy in registration is due in part to the fact that the M. C. B. association this year charged its members and guests for all badges; and with both railway associations badges were not given out as freely as heretofore. It would be interesting to know the average amount of time spent here by each railway man this year as compared with a year ago; but naturally a computation of that kind is not now possible. Whether or not the increased attendance at the meetings and other ocular evidence contradicts the registration, it is nevertheless true that the businesslike attitude of the railway men, and their increased interest in the exhibits, gives one the distinct impression that this year's conventions were bigger and better than those held a year ago.

CONSOLIDATION

AGAIN the movement for the consolidation of the two great railway mechanical associations seems to be on the verge of settling back into a condition of quiescence. It was reported at the Master Car Builders' convention that the matter was being considered from the legal standpoint, but there was no intimation of what might be the objections or whether there were any probability of their being overcome. The consolidation committee of the Master Mechanics' Association went still further, or perhaps not as far, by reporting that there seemed to be a sentiment adverse to consolidation, and that the usefulness of its committee was at an end. The committees of both associations have been continued to the next meeting of the executive committee, with the seeming probability of their going out of existence immediately after that meeting.

The matter of such a consolidation is a most important one. The two associations have undoubtedly given more valuable technical literature to the world than any others. Outside their own membership there is a wider interest that would make against anything that would tend to curtail or depreciate in the slightest the output of the future.

The subject has been up for periodical consideration for the past twenty years or more. At first the suggestion came from the Master Mechanics' Association and was vehemently and emphatically approved by the master car builders, because the latter were, at that time, lesser officials, and were not recognized as of serious importance in the railway world. It was the opinion of the members that if a consolidation were effected the result would be the obliteration of the influence of the master car builders. With the advent of the representative member and the official control of the formulation and administration of the rules of interchange the tables were turned, and the master car builder became the prominent factor. This destroyed that feeling of jealousy that had previously existed and changed the source of opposition completely.

The argument for consolidation has been based, of recent years, on the ground that the same men control both locomotive and car departments, and that it is absurd that some men should be master car builders one week and master mechanics the next, simply because they were considering cars at one time and locomotives at another, while both have so many things in common. The plea for the continuance of the old conditions is based on the standing of the minor officials who are still separated into the two classes of car and locomotive men, and who each have their interests and problems that deserve attention. The argument for one association and one long week of convention work is answered by the statement that there are limits as to what men can and will do. A full week of continuous convention is too much, and the two days of relaxation between the present sessions permits of the prolonged period of interest without weariness, while, for those who do not attend both conventions, there is really no loss of time.

The result is that the opposition to consolidation has ceased to be an association matter and has become a matter based on individual opinion. Individuals are for or against it, regardless of whether they are car or locomotive men, and from present indications those favoring it are decidedly in the minority.

LOCOMOTIVE BOILERS

IT is so difficult that the difficulty amounts to an impossibility of considering within allowable limits that wide range of compiled practice and experience brought together in the report on the Design, Construction and Inspection of Locomotive Boilers. It is so comprehensive and covers so wide a field that even the convention seemed to be at a loss as to the best method of approaching and handling it in discussion. The result was that it skirted along on the edges, made a dab at some of the details, lost sight of others entirely and showed by all signs that it needed more time than was available to discuss fully this exceedingly important subject.

As it was, it confined itself exclusively to details with one important exception and that lay in the announcement of the policy that it had been decided to pursue in regard to the Federal boiler inspection, which does not seem to be progressing as smoothly as might be desired. The trouble lies mainly in the difference in the interpretation of the law by the district inspectors. The movement, therefore, is to secure uniform instructions for the inspectors. To attain this end the large committee, so distributed as to be representative of the whole country, is a proper one and will probably be an efficient means of dealing with the problem.

Aside from this the discussion and the report dealt with details that were almost innumerable: the shape of staybolt heads, the use of the combustion chamber, the width of water legs, the flanging of the fire door, the scarfing of plates at the round ring, the radius of round ring corners, the comparative influence of coal and oil on the sheets, the methed of fastening tubes, and so on, and so on. But there was one feature noticeable throughout the whole, and that was the slight differences of opinion expressed and how those slight differences might be explained by differences in the local conditions that called them forth. The widest difference, perhaps, was expressed by the two speakers, one of whom rather favored, though he by no means advocated, the return to the narrow water leg of the firebox as contributing to an improved steaming of the locomotive, and another who was getting most excellent results with a 7 in. leg. No very specific data was offered by either, but the coal and water, as well as the traffic conditions, of the two roads were so different that it was scarcely to be wondered at that they found a difference in boiler construction desirable.

It seemed strange, with the possibilities before them, that the effect of check valve location for the feed, the circulation, the stresses on braces and sheets did not receive even a passing notice.

The expression of the opinion that the locomotive boiler was destined to grow in the future, and that the limits of its development had not been reached, showed confidence in its construction, and the brief outline of its history from the crownbar type with the narrow firebox to the almost universal use of the radial stay with the Belpaire as a side or intermediate construction was an interesting summation of what had been done. The mechanical stoker seems to be the instrument that is looked for to modify firebox and boiler construction, and especially to modify its dimensions. This seems to be especially probable in view of two facts that have been brought out: one the great quantity of coal that the mechanical stoker can handle, and the other the recent tests showing the high percentage of the total evaporation of the boiler that is attributable to the firebox. The combination seems to indicate the uselessness of adding to the length of the tubes and the desirability of adding to the length and width of the firebox and the use of the combustion chamber.

These are some of the more important of the items touched on and regarding which there might be and will be much discussion in the future. Whether they will be treated with the same thoroughness that was given to the details of construction in the paper of this year remains to be seen. But the committee that will probably be appointed to report on the operation, care and maintenance of boilers at the next convention has a large subject to handle, a broad field in which to operate and an opportunity to present a report that will be second to none in interest and value, not even to this most excellent one which was presented yesterday.

THE ENTERTAINMENT FEATURES.

PROBABLY no other subject has been so much discussed during this year's convention as the entertainment features. The entertainment programme had been gradually elaborated in past years until it had come to include a large number of formal affairs. It had become the custom to wear formal dress for these formal occasions, and there had developed a good deal of display, and even of rivalry in this display. The joint executive committee, composed of the presidents of the Master Car Builders' Association, the Master Mechanics' Association and the Railway Supply Manufacturers' Association, after mature consideration, decided that, in view of existing conditions in the railway business, a change should be made, and this was done. The formal receptions to the officers of the associations were abolished, and informal evening social gatherings substituted. Similar action was taken in reference to the grand balls, which were superseded by informal dances. The vaudeville entertainments and the card parties with their prizes, were eliminated. The furnishing of roller chairs for railway men, supply men and their guests, by the Supply Association was stopped, each being left to pay his own way. The members of the entertainment committee have appeared at evening social functions in their business suits. The much reduced entertainment expenses have been borne jointly by the railway and supply associations instead of—as in past years—by the supply association.

These were radical changes, and it is not surprising that many expressed grave doubts as to their probable effects, and that honest opinions have differed widely as to their wisdom and results. Many believed that one effect of the reduction of the public general entertainment would be an increase in the amount of more or less concert entertainment of individual railway men by individual supply men, and all agreed that this would be an undesirable consequence. The Daily has closely observed the course of events and made inquiry of numerous persons, and in spite of some conflict in the evidence, our conclusion is that there has been no increase in individual entertainment this year, and that probably there has been even a reduction in it. Never in the history of the conventions, in our judgment, have those attending them been more careful in their conduct. There has, however, been a good deal of complaint about the entertainment features being "slow"—a thing which, of course, no one charges up to the entertainment committee, which has simply acted under orders. Many have also thought that the informal dressing has been carried to an extreme. The worst complaint of all has been made because of the failure this year to provide rolling chairs free for all persons wearing badges.

If one is to reach a correct conclusion as to what should be done about the matters referred to, he must begin by considering the purpose of the mechanical conventions. Their object is to afford the mechanical officers of the railways opportunity to so increase their knowledge of the important and difficult subjects with which they have to deal as to increase the efficiency of their labors for the railways by which they are employed. Anything that interferes with the attainment of that object has no proper place among the features connected with these conventions. During recent years the limelight of publicity has beaten with increasing fierceness on the railways, and their execu-

tive officers have grown more and more sensitive regarding the doing of anything which might be construed in such a way as to reflect any discredit on railway management. The original intimation that the soft pedal should be applied to certain diversions in connection with the conventions, which might be perfectly innocent but open to misconstruction, came from the executive officers, and the changes made this year amounted to an expression of opinion by the executive officers and men of leading influence in the mechanical associations, that some features in connection with the conventions interfered with their serious business or were open to misconstruction. It was felt that the formality of some of the entertainment features caused some persons to dress with a lavishness that was excessive for such occasions, and that the costly dressing of some restrained others, who were quite unable to compete with them, from attending the grand balls, the card parties, etc. It was also felt that the policy of permitting the supply association to defray all of the expenses of entertainment, including the cost of the rolling chairs, was open to the criticism that it established an improper relationship between the supply fraternity and the railway men.

The RAILWAY AGE GAZETTE expressed the opinion after the conventions a year ago, and reiterates it now, that it is not the entertainment of all the railway men by all the organized supply men that may do harm, but excessive individual entertainment. Undoubtedly, however, the most satisfactory plan of all is for the railway associations to share in the entertainment expenses as they have this year. The supply men, with great enterprise and at great expense, furnish the greatest exhibit of its kind ever made in the world. Why should they be put to the additional expense of paying for all of the entertainment, too? Certainly there is no objection to those who are anxious to wear their evening clothes doing so; but the feeling that this is a necessity at social affairs in connection with purely business conventions has been simply ridiculous and ought to be ridiculed to death as it deserves.

It would seem that in the future all of the social features—if the conventions continue to be held in Atlantic City—should be held in the evening on the pier where there is plenty of room; and one of the greatest improvements that could be introduced would be that of keeping the exhibits open at night. This is done at practically every other industrial show in the United States, whether it be the Railway Appliances Association's exhibition in Chicago, or an automobile show, or an agricultural show. It is not every railway man who attends the conventions that wants to dance, and if the exhibits were kept open in the evening and all the social affairs were held on the pier, while those who wanted to were attending the social affairs, those who preferred to be looking over the exhibits could be doing that. It could easily be arranged for the representatives to the supply concerns to take charge in turns of the exhibits at night. Many railway men come to spend only a day or two at the conventions, and we have no doubt that they, and also many who stay much longer, would welcome as a great improvement the innovation of keeping the exhibits open at night.

Whatever criticisms the plan followed this year may be subject to, it is a move in the right direction. The one principle to be borne in mind is, that everything else should be made decidedly subsidiary to the business purposes of the associations. The sessions of the conventions come first, and full opportunity to study the exhibits comes next, in importance; and whatever, to any considerable degree, interferes with these things, or may be construed as interfering with them, should be frowned down. The extent to which these things are borne in mind, and action accordingly taken, may determine the entire future of the conventions and the exhibit.

Announcements.

TO-DAY'S PROGRAM.

M. M. ASSOCIATION.

Discussion of Reports on:	
Safety Appliances	9.30 to 9.45
Flange Lubrication	9.45 to 10.30
Minimum Requirements for Headlights	10.30 to 11.00
Standardization of Tinware	11.00 to 11.15
Maintenance of Superheater Locomotives	11.15 to 12.00
Engine Tender Wheels	12.00 to 12.30
Resolutions, Correspondence, etc	12.30 to 12.40
Unfinished business	12.40 to 12.45
Election of officers	
Closing exercises	12.45 to 1.30

B. & O. CLUB.

In addition to those B. & O. men who met Monday and organized the B. & O. Club, the following B. & O. men signed the register on the desk of the American Car & Foundry Company in its space No. 610; also there were several in attendance at the meeting whose names were inadvertently omitted: J. F. Deems, J. B. Emory, Rush Gramm, Harry M. White, F. J. Cole, H. H. Hale, A. H. Reeves, J. T. Carroll, D. H. Reeves, O. C. Cromwell, E. J. Searles, John Moran, S. C. Granis, C. M. Harris, F. H. Carr, J. F. Francis, E. P. Stevens, C. W. Burke, F. P. Pfahter, G. W. Keller, F. C. Schorndorfer, H. D. Van Valin, L. A. Kennedy.

Present and past employees of the B. & O. who regularly attend the annual M. C. B. and M. M. convention are invited to join the club and to send their names and addresses to the secretary, Charles L. Sullivan, 1601 McCormick Building, Chicago.

FOUND.

A small enameled high school or college pin. Apply to Secretary Conway's office.

BADGE PRESENTED TO PRESIDENT STAFFORD.

It is the custom of the Railway Supply Manufacturers' Association to each year present its retiring president with a past-president's badge. The badge presented this year to Mr. Stafford was accompanied by the following letter, signed by all of the other members of the committee:

"The position of president of the Railway Supply Manufacturers' Association is one of honor and distinction. The conferring of that honor upon you was richly deserved, and the wisdom of that action is proven by the distinguished credit to yourself with which you have filled the post.

"During your administration you were confronted with new and perplexing problems, affecting not only the immediate welfare, but the future, of our association. The careful, conservative manner in which you solved these problems and the consecration of time and effort in their solution, call for the highest commendation.

"The association, through its executive committee, in presenting you this past-president's badge, exercises the only means it has for material expression of its appreciation of the magnificent performance of the exacting duties; but it acknowledges thereby its debt to you for your faithful, self-sacrificing and highly efficient service. The badge itself tells its story of honorable ambition most creditably achieved.

"The responsibilities of office you will soon lay on other shoulders; but the satisfaction of duty well done, and the affectionate regard of your associates, are yours for all time."

Proceedings.

Vice-President Crawford called the meeting to order at 9.50 a. m.

CONSOLIDATION.

Chairman Crawford: This committee has given consideration to the subject of consolidation, and would report that the general feeling does not seem to be in favor of it. The matter was quite well expressed in President Bentley's address yesterday, but inasmuch as the M. C. B. Association has continued its committee on consolidation, at least until such time as the executive committee meets again, Mr. Crawford made a motion, on behalf of the committee, that the committee of this association be continued, at least until the next meeting of the executive committee.

The motion was seconded and carried.

F. F. Gaines (C. of Ga.): I would ask if, in continuing the committee, the committee will consider the suggestion of President Bentley relative to the proposed change in the meeting time. He made some suggestions in his report to that effect.

The Vice-President: I should say that would be considered by the executive committee at the July meeting, when the committees are appointed, and such matters are given consideration.

DESIGN, CONSTRUCTION AND INSPECTION OF LOCOMOTIVE BOILERS.

The committee has the following report to make in regard to design and construction of locomotive boilers: The report on inspection was presented to the members at the last convention. A circular of inquiry was sent to all the members of the Association in regard to their experience and recommendations concerning the construction of locomotive boilers. Replies were received from 29 members, comprising a total of 29,355 locomotives, including the supplementary report that was presented at the convention. The intention of this committee is to give the different members the benefit of the experience of the different railways.

Type of Boiler.—In no case is a special type of boiler used for any special service. One of the members advises that they use Belpaire boilers of crown bar construction for road engines entirely on account of greater ease in maintaining staybolts. Another member advises that they use the Belpaire boiler as well as the radial stay boiler, and their experience with the Belpaire

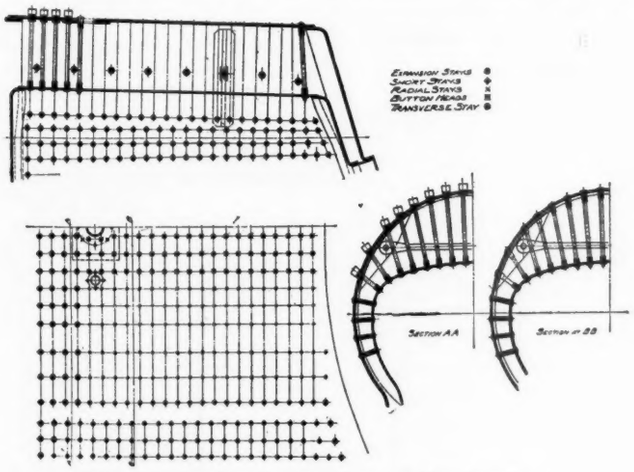


Fig. 1—Crossbracing for Locomotive Firebox.

boiler is that it reduces the number of staybolt breakages. From the experience that they gained with Belpaire boilers, they developed a system of cross-bracing, shown in Fig. 1, which has practically all the advantages of the Belpaire staying, and in addition it reduces the dead weight and is cheaper to construct.

A member of a road operating over 1,000 locomotives advises that they use Belpaire boilers with button heads to support crown sheet, claiming it is stronger, easier to clean and gives more steam space. Another member from a road operating 900 locomotives advises that they have engines with Belpaire, radial stay and crown bar boilers; crown bar boilers are used on older type of engines and have proven unsatisfactory. Radial stay boilers have been used on later types of engines and have generally been satisfactory, except in bad-water districts where broken stay bolts and cracked firebox sheets have given more trouble as compared with the Belpaire boilers used in the same district. This is attributed to a more equal distribution of stress. Radial stay boilers are used on passenger, freight and switch engines where Belpaire is used only on freight engines.

From the replies received from the different members it is the consensus of opinion that the radial stay type of boiler is preferred, as it is easy to construct, giving more free circulation of water, less deposit of sediment on the crown sheet and easier to wash out; also the dead weight is kept down considerably.

Combustion Chambers.—From the replies received the combustion chamber is only favored by 5 members. One member, who uses the combustion chamber covered by Fig. 2, advises that it shows a great economy in fuel, a decrease in the amount of

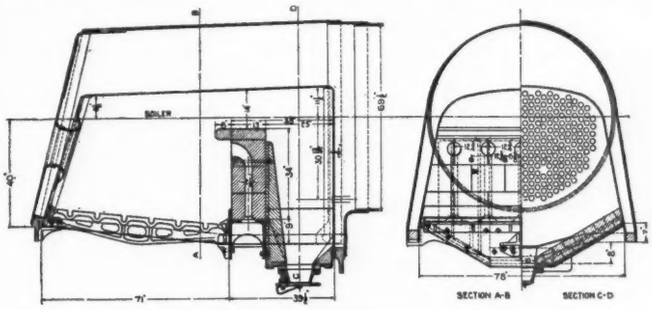


Fig. 2—One Type of Combustion Chamber.

smoke and cinders and increased mileage. No information was given in regard to maintenance. Another member advises that the reason they favor the combustion chamber in certain types of boilers, such as Mallet, is that it keeps the tubes a reasonable length and increases the heating surface of firebox. No information was given as to the fuel economy derived from these combustion chambers, but a saving in maintenance and an improvement in performance is reported. The type of combustion chamber he uses is covered by Fig. 3.

Another member reports being in favor of combustion chambers, but does not have them on all engines. This member was

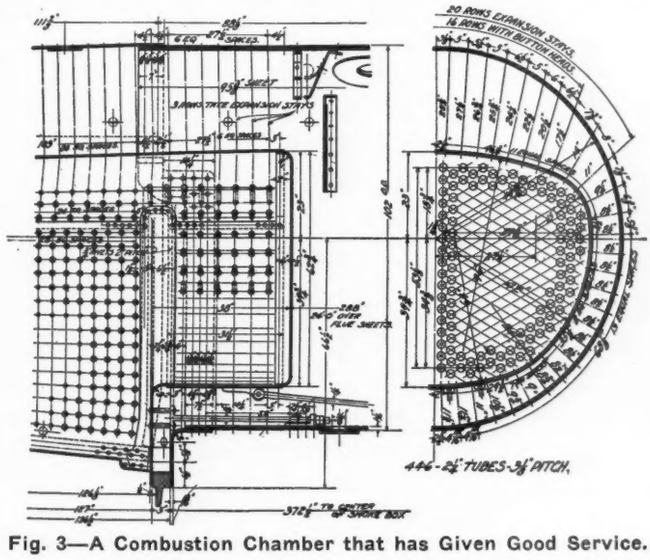


Fig. 3—A Combustion Chamber that has Given Good Service.

from an anthracite road and the particular claim was they thought they got better combustion and also derived a good deal of benefit in the way of protection of flues, particularly so, the boxes being extremely shallow below the flue sheet. Another member advises that they have had all combustion chambers removed on account of costing too much to maintain.

The advantages claimed by the use of combustion chamber are that it keeps the tubes within a reasonable length, protects the flue beads, increases the firebox heating surface and gives better combustion.

The committee feels that a combustion chamber is desirable on boilers with extra long flues, such as Mallet and Mikados, but are not prepared to recommend any particular design.

Firebox.—Continuous crown and side sheets are favored by all

of the members except one. Therefore, the committee recommends the use of continuous crown and side sheet for new construction or with renewal of firebox.

Mud-ring Corners.—The committee recommends mud ring with large radius, and the flanges of the tube and door sheet should be carried back far enough to get at least three straight rivets through the ring. Scarf the inside sheets down to be properly fitted to the mud ring by heating them. If the scarfing and the fitting of these sheets is given proper attention it will overcome leaky mud-ring corners that some of the members are now experiencing considerable difficulty with.

Throat Sheet.—From the replies received, the distance from the top of the grate to the bottom of the lowest boiler tube on wide firebox engines is a minimum of 14 in. and a maximum of 26 in., average about 22 in. Narrow fireboxes have a minimum of 13 in. and a maximum of 28½ in., average about 20 in. One member who uses hard coal advises a distance of 8⅛ in. minimum and 12 in. maximum. This height is limited due to the design of the locomotive.

The committee recommends as deep a throat sheet as the

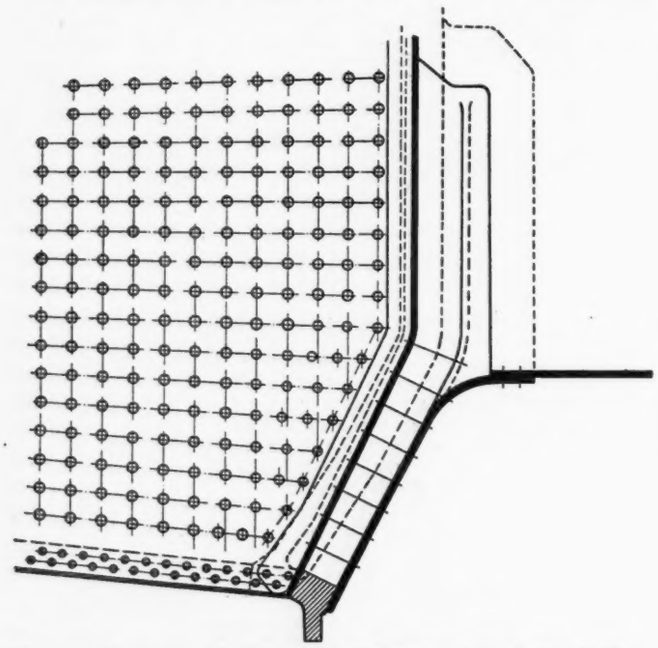


Fig. 4—Recommended Design of Throat Sheet for Boilers With Sloping Mud Ring.

design of the locomotive will permit. The committee also suggests the design of throat sheet as shown in Fig. 4, on boilers with sloping mud ring to allow for more uniform spacing of stay bolts and location of arch tubes and simplifies the flanging of the throat sheet and flue sheet. One of the members operating over 1,500 locomotives uses this design on the latest type of boilers. Boilers having a sloping mud ring with a firebox 60 in. long by 68 in. wide, throat sheet is 25⁵⁄₁₆ in. deep; fireboxes 120 in. long by 61. in wide, throat sheet is 15⅝ in. deep.

From the replies received in regard to thinning out of flue and door sheets, also the use of countersunk rivets where these sheets are joined to the side sheets, you will find the different methods followed out in Fig. 5. About 50 per cent. of the members thin out these sheets and apply countersunk rivets. It is generally acknowledged that the thinning of the sheets and the countersinking of rivets is necessary on oil-burning locomotives. The general practice seems to be to countersink these rivets about half way up the side sheet. No data were given in regard to which practice is the best from a maintenance standpoint.

Spacing of Rivets in Firebox Seams.—The committee suggests ¾-in. rivets spaced 2 in. apart, as this is used by the majority of the members who replied to the circular.

Design of Fire-door Hole.—Fig. 6 shows various designs of fire-door holes used by different members. Five members advise that they use style No. 2, which is the O'Connor type of fire-door. One of the members reports that they have 1,200 locomotives equipped with the O'Connor type of fire door for a number of years. On boilers equipped with this type of fire-door flange they have had several cases where the door sheets have remained in perfect condition although two sets of side sheets and a second back-flue sheet had been applied and cracked badly. In every instance the door hole remained in practically perfect condition when the rest of the firebox was cracked to the point of renewal. Boilers equipped with this type of fire-door hole gives larger water space, fewer stay bolts about the door seam, seems to give freedom for expansion and contraction and also largely prevents mud and scale collecting

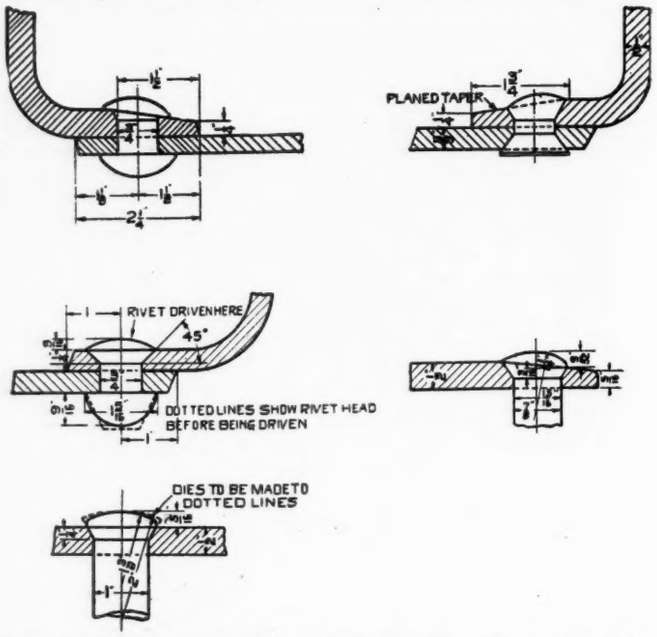


Fig. 5—Methods of Jointing Door and Flue Sheets to Side Sheets.

at this point. It seems to the committee that style No. 1 would have a tendency to collect mud and burn out. The committee has no choice between styles Nos. 2, 3, 4, and 5.

Number and Size of Fire Doors.—It is found that various

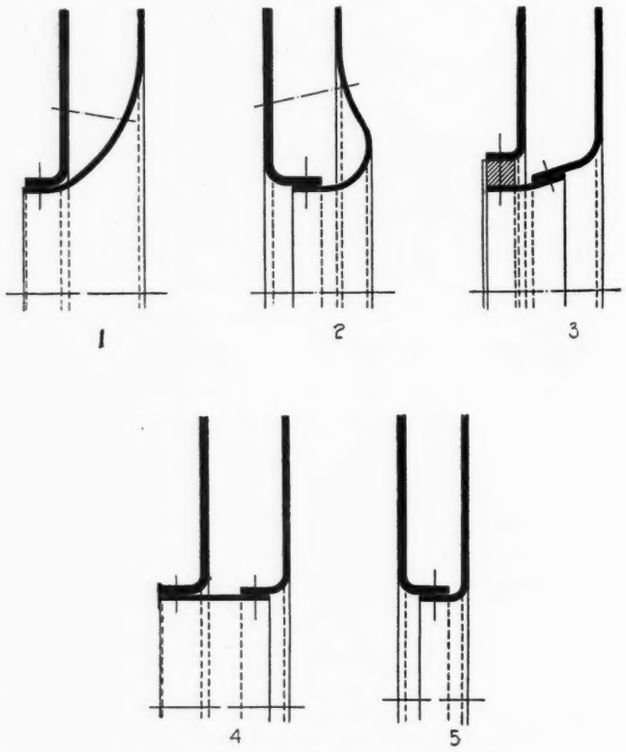


Fig. 6—Types of Fire-Door Holes.

sizes and numbers of door holes are used on different types of boilers.

Arch Tubes.—Of the replies received, 20 members use 3-in. tubes, one member uses 2-in. tubes and one member uses 2¼-in. tubes. Eight members do not use arch tubes at all. One

member supports brick arches with studs fastened into the side sheet.

Thickness of tubes used: 15-in., 165-in., 18-in., 203-in., 25-in. Eight members use thickness of .18-in. Eleven members use seamless steel, one member uses charcoal iron, thickness of tube not given.

Plugs or Plates for Covering Arch Tube Holes in Throat Sheet and Back Head.—Fourteen members use brass plugs, one member uses extra large size brass plugs for covering the holes; these plugs are drilled for 2¼-in. plug so as to avoid removing the large brass plugs when washing the tubes. Three members use plates with ball joints, as shown in Fig. 7, claiming greater ease in removing and applying in close quarters.

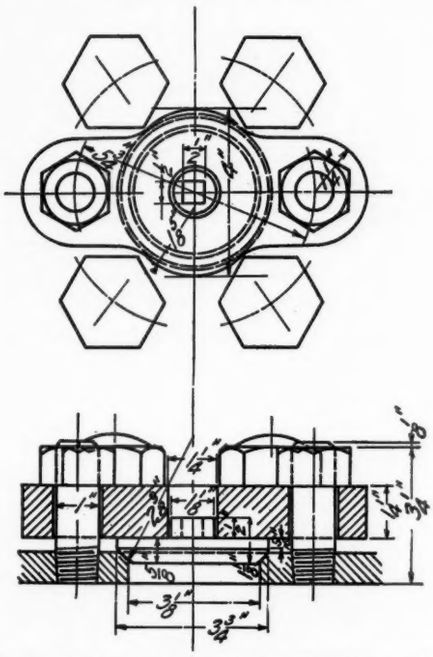


Fig. 7—Plates for Covering Arch Tube Holes.

Method of Setting Arch Tubes.—The setting of arch tubes varies. The replies received were indefinite as to just what practice they are following out. Six members did not state whether they use copper ferrules or not. Nine members advise that they use copper ferrules in setting arch tubes. Three members set the arch tubes without ferrules. Three members set the tubes with a roller expander and a sectional expander to be used in the ordinary manner to set out the tube, as shown in Fig. 8 (A). Tubes are then beaded over with a bootleg

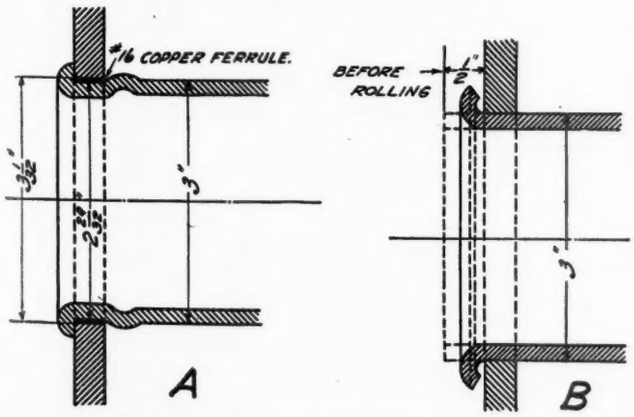


Fig. 8—A Type of Arch Tube Setting.

tool, except by one member who bells out the tube on the water side to prevent the tube from pulling out of the sheet. This member does not use any ferrules. The other two members do use copper ferrules. Fig. 8 (B) shows the arch tube setting as used by one member.

For the information of the members you will find complete set of instructions for setting arch tubes, which is being used by several large roads with success. This covers tubes expanded and beaded on the outside as follows:

Original holes in firebox sheet must be 3 3/32 in. in diameter. Worn holes must be reamed when more than 1/16 in. out of round. Sharp edges must be removed by slightly rounding with file or reamer.

Copper ferrules must be used at both ends of arch tubes. Ferrules should be 3 in. outside diameter, .095-in. thick and ⅝-in. long, expanded by carefully hammering on a round mandrel to snugly fit the hole. Ferrules should be set with 1/16-in. projection on each side of sheet and secured in place with a roller expander.

Tubes must be 3 in. outside diameter, 18-in. thick seamless drawn steel. The tubes should be cut to proper length and bent to template conforming with drawings. The length can only be determined by actual measurement of the firebox and allowance must be made for projection of ½ in. into water space at each end of firebox. Tubes must then be securely fastened with the roller expander. See Fig. No. 1, in Fig. 9.

After tubes have been set they must be flared at both ends with the flaring tools shown in Fig. No. 2 of Fig. 9. After the tube ends have been thoroughly flared the tube ends are then ready for beading.

Additional flaring with tool shown in Fig. No. 3 of Fig. 9, is necessary to start the bead. The bead must then be formed with special beading tool, Fig. No. 4 of Fig. 9. Notice that it is not desired to form a full bead. The bottom of bead should stand 1/16-in. clear of the sheet.

These tubes should be thoroughly examined and cleaned at each washout of the boiler. At the least indication of scale formation in the tubes the pneumatic tube cleaner must be used. The tube cleaner should be secured

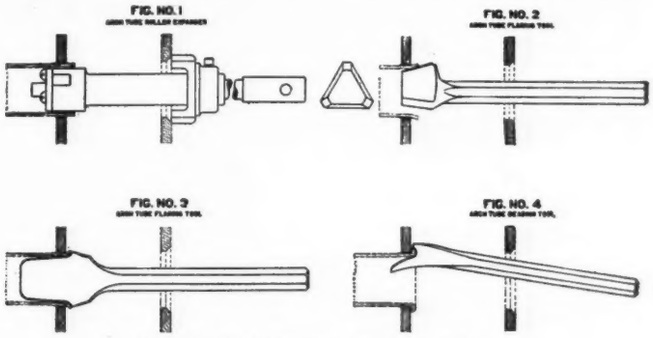


Fig. 9—Maintenance of Arch Tubes.

to a length of ½-in. air hose to which is attached another ½-in. hose for supplying water while cleaning. Care must be taken so as not to break the cleaning cutters by allowing the cleaner to be pushed through the opposite end of the tube. A stop must be provided on the hose set at the proper length for this purpose. The tube cleaner must be lubricated with signal oil fed through a lubricator in the air-supply pipe at the rate of 30 drops per minute. After cleaning, the tubes must be inspected by holding a light at the opposite end of the tube to make sure that the tubes are thoroughly cleaned and free from scale. Leaky tubes must be stopped from leaking by rolling with an expander. Before rolling the tube ends must be thoroughly cleaned from scale.

The committee has been unable to get any information in regard to which type of flue setting gives the best service, therefore are unable to make a recommendation as to which type should be recommended as standard practice.

Radius of Flange in Back Tube Sheet.—Replies received in regard to the radius in the back tube sheet where it connects to the crown sheets. Recommendations were made from ½ in. up to 2 in. Some members had trouble with cracked sheets and leaky seams with large radius; others had trouble with the small radius. One member advises that he is now experimenting with a 4-in. radius and it seems to give good satisfaction, but it has not been in use a sufficient length of time to give a complete report. Two members increased the radius from ⅞ in. to 2 in. and had considerable trouble with the flue sheet working up and the flanges cracking. Two-inch radius has been discarded and they are now using ⅞ in., which improves the condition but does not eliminate the difficulty entirely. Another member reports a 3-in. radius satisfactory.

Distance from Inside of Flange of Back Flue Sheet to Edge of Flue Holes.—The committee recommends that a distance from the inside of the back flue sheet to the edge of the nearest flue hole to be ample to prevent the flue sheet cracking through the flange. This distance will vary, depending on the radius of the flange of the tube sheet. In tube sheets with ⅞-in. radius, this distance should be at least 2 in. at the top, ⅞ in. on the side. Sheets with 2-in. radius, this distance should be at least 2½ in. at the top.

Throat Sheet Brace.—The committee had the members submit designs of throat-sheet belly brace used and Fig. 10 shows 12 styles of braces, the design of brace for this location to be such as to avoid any mud pockets and so as to allow for proper circulation of water.

Method of Supporting Grate Side Frames.—The committee recommends the grate frames to be supported from studs in the mud ring or brackets fastened to the under side of the mud ring, the latter forming a pocket for the grate side frame to fit into.

Sloping Back Heads.—Sloping back heads are used by practically all of the members who replied to the circular. The

slope varies from 8 degs. to 20 degs., making an average slope of 12 degs. Sloping of back heads gives additional room in the cab, reduces the weight of the boiler and gives a maximum length of fixebox, and still remains within a reasonable limit for hand firing.

Staybolts.—Uniform spacing of all staybolts in all parts of the firebox is recommended by the committee. The majority of the members reported the use of button-head crown stays for the 6 to 9 center rows of the crown sheet the entire length; two members use hammered heads for the first 4 or 5 rows from the flue sheet.

The committee favors the use of button-heads on as many rows as the design of firebox will permit, but recommend for the consideration of members the practice of using hammered heads on the first 4 or 5 rows back from flue sheet.

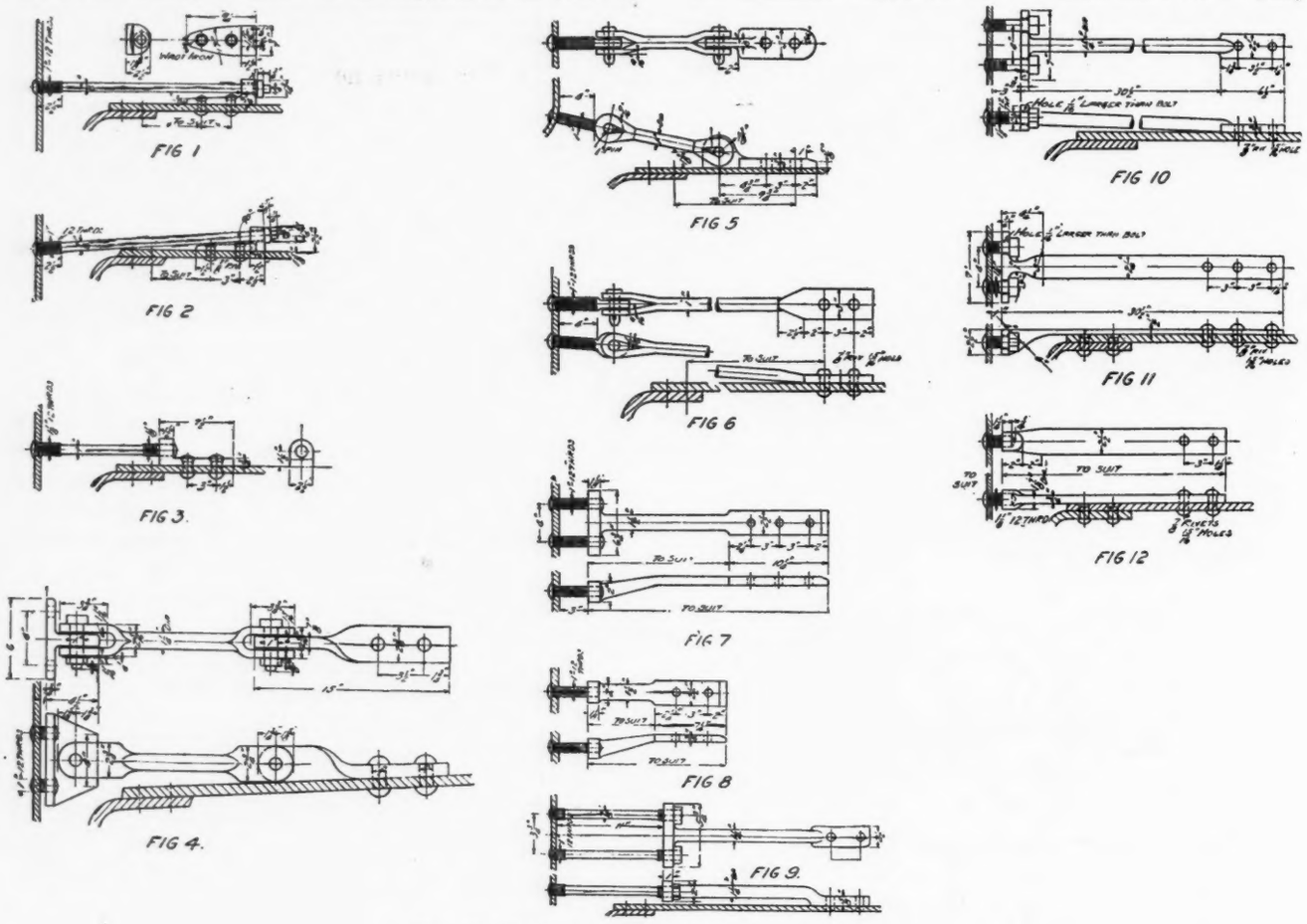


Fig. 10—Designs of Throat-Sheet Belly Brace.

Sling Stays.—Figs. 11 and 12 show the various types of sling stays in use by the different members and no difficulty with any of these types have been reported. Three members use a special flexible staybolt on all new equipment, and the use of this type of sling stays is also favored by, but not used by,

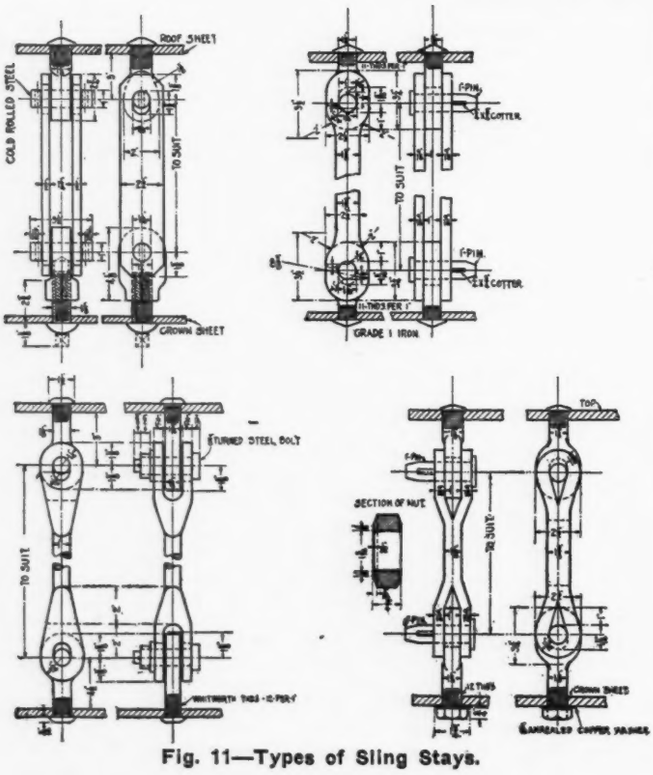


Fig. 11—Types of Sling Stays.

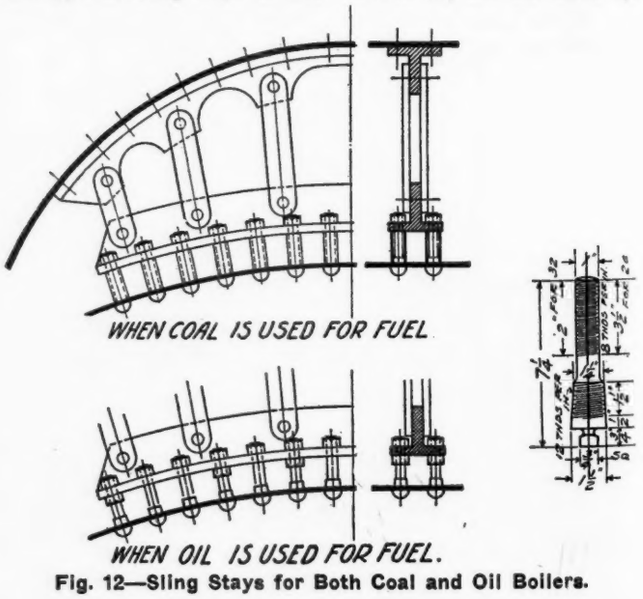


Fig. 12—Sling Stays for Both Coal and Oil Boilers.

another member. Sling stays are used to the extent of 2, 3 and 4 rows back from the tube sheet on boiler with combustion chamber.

Flexible Staybolts.—Of the members who have replied, all except one member use flexible staybolts. Most of the members apply these in the breakage zone. Five members are making full installation of flexible staybolts on boilers with wide fireboxes, and one member uses them in the throat sheet, only. One member has the following report to make:

"In February, 1907, engine received a new firebox with a full installation of flexible staybolts, with the exception of 4 bolts under the auxiliary dome and 4 under the steam turret; also 8 bolts which go on top at the back head. February, 1908, the engine received general repairs and the firebox was in good condition. All caps were removed from the flexible staybolts and they were found to be o. k. In April, 1909, it was found necessary to patch the top of the back tube sheet on account of the sheet cracking from the hole around the flange; this was done in the engine house. In October, 1909, the engine was given general repairs, and by this time the top of the back tube sheet had given out in two more places, but as the sheet was in good condition otherwise it was patched. Three of the mud-ring corners also had to have small patches applied. After rattling the scale from the firebox sheets with a large hammer, it was found that 40 of the flexible sleeves had cracked outside of the sheet, and on being taken out they were found to be crystallized, but no broken bolts were found. In 1911, the engine was again in the shop for general repairs and had all the caps removed from the flexible staybolts and the bolts found to be o. k. A patch was applied on the top flange of the flue sheet, but the half side sheet seam in the firebox was in good condition. When the engine is shopped again it will be necessary to renew the back flue sheet on account of its being patched. This engine has made 319,567 miles to November, 1911, and has lost no time due to broken staybolts."

One member advises that they have equipped some fireboxes with a full installation of flexible staybolts, but can see no advantage in doing this. In their opinion the flexible staybolts are only advantageous when applied in the breakage zone, and

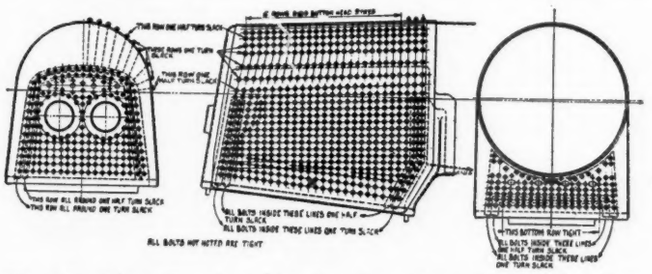


Fig. 13—Rivet Spacing Showing Location of Flexible Staybolts.

they have discontiuued making full installations and are only applying them in the breakage zone. However, a full installation of flexible staybolts in the throat sheet is being used by quite a few members with good results.

Three members advise that they allow a certain amount of slack when applying flexible staybolts. Fig. 13 shows the amount of slack and the location followed out by one of the members. It is the brief that an application of this kind will decrease the number of broken staybolts and allow for a greater expansion and contraction, which prevents the cracking of firebox sheets and increases the life of firebox correspondingly.

The committee believes that this is a subject worthy of further consideration and would suggest that some more of the members carry on a further investigation and make a report at some future date to this Association.

Tube.—It is the consensus of opinion of those reporting that 2-in. tubes are preferred, until the length of tube exceeds 16 ft., when 2¼-in. tubes are then preferred.

Taking into consideration that a 2-in. tube will give a greater amount of tube heating surface, and the cost of maintenance is less, and less damage is done to the tube sheets in working over the flues, the committee suggests that further consideration be given to the use of 2-in. tubes in lengths greater than 16 ft.

Thickness of Front Tube Sheet.—One-half inch and ⅝ in. are used by the majority of the members who replied to the circular. One member uses 9/16 in. and another ¾ in.

Thickness of Back Tube Sheet.—One-half inch tube sheets are being used by 16 of the members. Two members use 9/16 in. and one member uses ⅝ in. All but three report having more or less trouble with flue sheets working up on account of frequently working on the flues, causing the flue sheets to crack across the top of the flange of the sheet. One member reports that this trouble occurs only on the radial type fireboxes. The crown bar and Belpaire type never crack in this way. The top flanges get bent down on the two latter types, the same as in the radial type, but no cracking takes place. They have used eye bolts in crown sheet and roof sheet and sling braces between; also have a number of boilers equipped with flexible expansion stays in the first four rows across the front end of crown sheet, but there does not seem to be any method of bracing yet devised that will overcome this trouble. He suggested that the top of the flue sheet on radial type fireboxes be made straight across top for 24 in. each side of center and make front end of crown sheet conform to this shape.

Width of Bridges.—The width of bridge in the front tube sheet varies from ½ in. to 15/16 in. Three-fourths inch is used by the majority of the members. Width of bridge in the back tube sheet varies from 11/16 in. to 15/16 in. Three-fourths inch is used by the majority of the members.

Flue Setting.—Two members advise that they have tried out soft iron ferrules with very little success. One member advises that they had a limited experience trying to set flues in the back flue sheet without any coppers, but found that it did not work satisfactorily, and that they are now experimenting with a combined copper and iron ferrule, but have not had these under a test long enough to make any report. One member advises that they use soft iron shims on the front flues to avoid excessive expanding.

Setting of Flues in the Front Tube Sheet.—The consensus of opinion of the roads reporting is that tubes should be rolled in the front tube sheet without any ferrules, and 10 per cent. of the flues, equally distributed, should be beaded with a beading tool.

Tube Setting in Back Sheet.—Fig. 14 show the practice followed out by some of the members in setting the tubes, which are giving good results. Fig. 15 shows the application, maintenance and removal of flues in locomotive boilers as used by three members. Tube setting of this kind gives a large bridge, good circulation of water at the back tube sheet and at the same time the inside of the flue is reduced at the end, so that any cinders which will pass through the swedged end will not clog the flues. The instructions in connection with Fig. 15 are as follows:

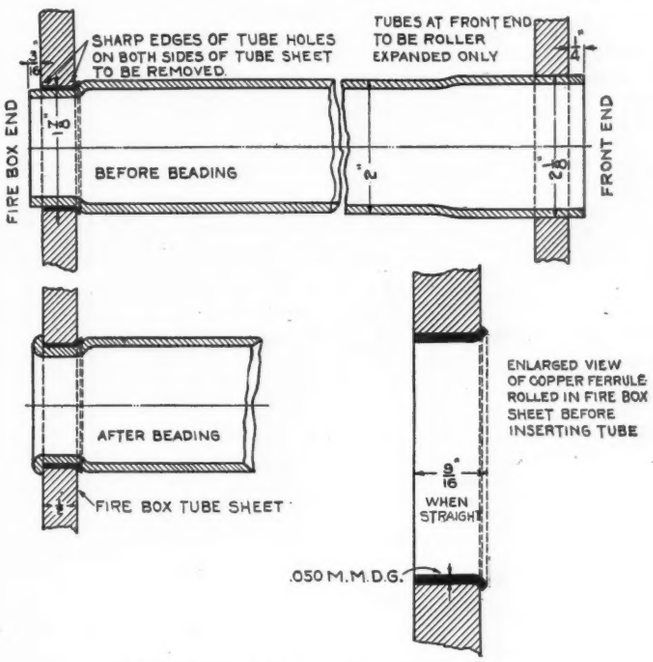

SHARP EDGES OF TUBE HOLES ON BOTH SIDES OF TUBE SHEET TO BE REMOVED.
TUBES AT FRONT END TO BE ROLLER EXPANDED ONLY
FIRE BOX END
FRONT END
BEFORE BEADING
AFTER BEADING
FIRE BOX TUBE SHEET
ENLARGED VIEW OF COPPER FERRULE ROLLED IN FIRE BOX SHEET BEFORE INSERTING TUBE
WHEN STRAIGHT
.050 M.M.D.G.

Fig. 14—A Method of Setting. Flues.

Holes in the new firebox flue sheet shall be 1⅞ in. diameter. Holes in the new smokebox flue sheet shall be 2 1/32 in. diameter. Holes in an old flue sheet more than 1/32 in. out of round must be reamed (reamer Fig. 1). Inside and outside edges of the flue holes in both sheets must be slightly rounded to remove any sharp edges. The following is the method used:

Flue-sheet Holes (Fig. 1)—Care should be taken that holes in flue sheet are true, smooth and free from burrs and sharp edges. It is desirable that the flue hole have a fillet especially on the water side of about 1/32-in. radius. A sharp edge around the hole often cuts the ferrule in two, even cutting into the flue. The diameter of the flue hole should be the same as outside diameter of flue plus 1/32 in.

Copper Ferrule (Fig. 2)—For New York this should not be far different from No. 16 B. W. G. In old flue sheets when the flue holes are large it is desirable to use enough heavier ferrules to bring the internal diameter

of ferrule when expanded into flue sheet to 1/8 in. less than flue diameter. The ferrule should be set into flue hole flush with fireside and expanded into place with Prosser expander, Fig. 3.

Swaging Flue (*Fig. 4*)—Great care should be taken to give the swage the right length and to have it terminate in as abrupt a shoulder as possible. The flue, after it is swaged, should be annealed and the scale removed from the portion entering the sheet. Grinding this scale off by machine is desirable, but in the absence of a grinder the removal of the scale with a file will answer. The flue when driven into the sheet (Fig. 5) should extend 3/16 in. through the sheet on the fire side.

Rolling (*Fig. 6*)—The front end of the flues having been shimmed, when necessary, both the back and front ends are rolled with the dudgeon or other suitable roller, with proper appliances they may be safely and economically rolled by air; the rolling of the back ends must be done by an experienced boilermaker, and the motor must not be larger than a Thor No. 22 or its equivalent.

Beading (*Fig. 7*)—This may now be done with a beading tool in an air hammer. Do as little hammering with the beading tool as possible, and do not work bead to a feather edge, but leave as much metal as possible for future caulking.

Expanding (*Fig. 8*)—Particular stress should be placed upon this, the most important step in the flue-setting process. Care should be taken that the flue shoulder when heavily expanded bears snugly and firmly against the flue sheet. Hammer not to exceed 4 lbs. after prossering the front ends, then bead a sufficient number for safety which finishes the flue setting. Back ends of flues or safe ends when used in back flue sheet must be cut off square in pipe machine and burr removed by reamer. Wheel-flue cutters must not be used on account of leaving a heavy burr which splits when beading over.

NOTE.—Air motor and roller are only to be used on initial setting. In reworking flues, the Prosser expander only is to be used, and rollers must not be used, as they force the bead away from the sheet.

Copper ferrules 1¾ in. inside diameter, ½ in. long, .095 in. in thickness shall be used in firebox flue sheet only. Ferrules shall be secured in place with straight expander, Fig. 2, taking care that shoulder of expander is tight against flue sheet, which shall bring edge of ferrule 1/32 in. from fire side of sheet.

Flue safe ends should be 5 in. in length, except that new iron flues shall have safe ends 4 in. long, and when these flues are first removed the 4-in. ends will be cut off completely and 6-in. ends applied, after which 5-in. ends should be used. Flues shall be swaged as per Fig. 4, to 1 11/16 in. outside diameter by 3 in. long, including taper at firebox end, for new work; for old work, just enough to enter the copper ferrule. All scale must be removed from swaged ends of flues before application. Smokebox end of flues shall not be more than 1/32 in. less in diameter than holes in the smokebox flue sheet. If necessary, liners may be used.

Flues shall be placed in back flue sheet with a bar, Fig. 5, and project ¼ in. through the sheet. Gage, Fig. 6, shall be used in checking location of flues. Flues shall then be fastened at firebox end with straight sectional expander, Fig. 7. While flue is being fastened it may be held in place at front end, using bar, Fig. 5. Straight sectional expander shall be checked with master gage, Fig. 8. Before using sectional expander, and in order to obtain exactly the proper length of flue for beading, flues may be rolled lightly to fasten them in sheet with roller expander, Fig. 15. After all flues are fastened they shall be flared at firebox end, using flaring tool, Fig. 9, and long stroke riveting hammer.

Flues at firebox end shall be expanded with sectional expander, Fig. 10, and long stroke riveting hammer. Roller expander must not be used. Pin shall be driven into expander until flue is solid against flue sheet. This must be done three times, expander to be slightly turned before each operation. The expanding shall be performed as follows: First, two vertical rows, from center to top of sheet. Second, same rows from center to bottom. Third, the two horizontal center rows from center to right. Fourth, same rows from center to left. Fifth, all remaining flues. All flues must be carefully inspected after expanding to assure that recess in each flue is the full depth to recess in expander and even all around the flue. Sectional expander, Fig. 10, to be checked with master gage, Fig. 11.

Flues in firebox flue sheet shall be beaded with standard beading tool, Fig. 12, and short stroke riveting hammer. Care must be taken so that nothing enters between head and flue sheet. Beading tool must conform accurately to master gage, Fig. 13, at all times. Smokebox end of flues shall be tightened with flaring tool, Fig. 14, before rolling takes place. All flues in smokebox end shall be rolled with roller expander, Fig. 15.

FLUE MAINTENANCE.

The firebox end of flues in service must be expanded at regular intervals with sectional expander, Fig. 10. This work shall be done when boiler is empty and all flues thoroughly cleaned out. Flue leaks in the firebox must be stopped with the sectional expander and not with roller expander nor beading tool. If beads are slightly away from flue sheet, standard beading tool shall be used to bring beads tight to sheet. Sectional expanders and beading tools must be kept standard by frequently comparing with standard gages. Any beading tool not conforming to gage must be sent to principal shop for repairs; these tools must not be repaired at any other shop. All shops and engine houses must be equipped with standard gages. All gages will be made where master gages are kept. To remove flues, use flue cutter, Fig. 16, for the front end, cutting off flues as close to the front flue sheet as possible. Back ends should be split as little as possible, so that it will not be necessary to use safe ends longer than 5 in.

Setting of Superheater Tubes.—Front Tube Sheet: Only eight members have had any experience with setting large superheater tubes. The practice followed out mostly is that

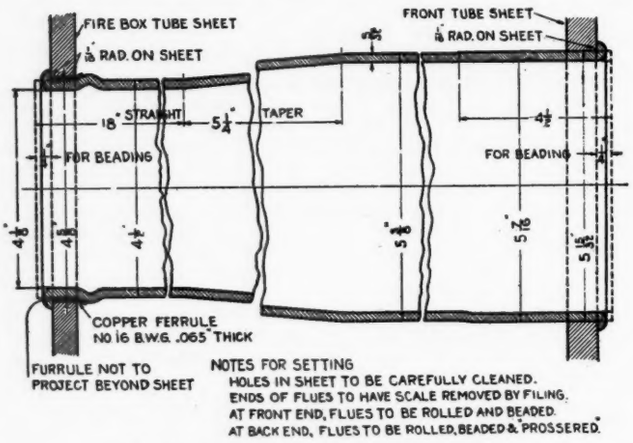

FIRE BOX TUBE SHEET
⅝ RAD. ON SHEET
FRONT TUBE SHEET
⅝ RAD. ON SHEET
18" STRAIGHT
5¼" TAPER
4½"
FOR BEADING
FOR BEADING
COPPER FERRULE
NO 16 B.W.G. .065" THICK
FURRULE NOT TO PROJECT BEYOND SHEET
NOTES FOR SETTING
HOLES IN SHEET TO BE CAREFULLY CLEANED.
ENDS OF FLUES TO HAVE SCALE REMOVED BY FILING.
AT FRONT END, FLUES TO BE ROLLED AND BEADED.
AT BACK END, FLUES TO BE ROLLED, BEADED & PROSSERED.

Fig. 16—Setting of Superheater Flues.

the tube is rolled and beaded as shown in Fig. 16, and this type of setting is suggested by the committee for further consideration.

Back Tube Sheet: Eight members advise that they use copper ferrules; one member who omitted copper ferrules is having good success with this method. The consenus of opinion of the roads reporting is that the type of setting shown in Fig.

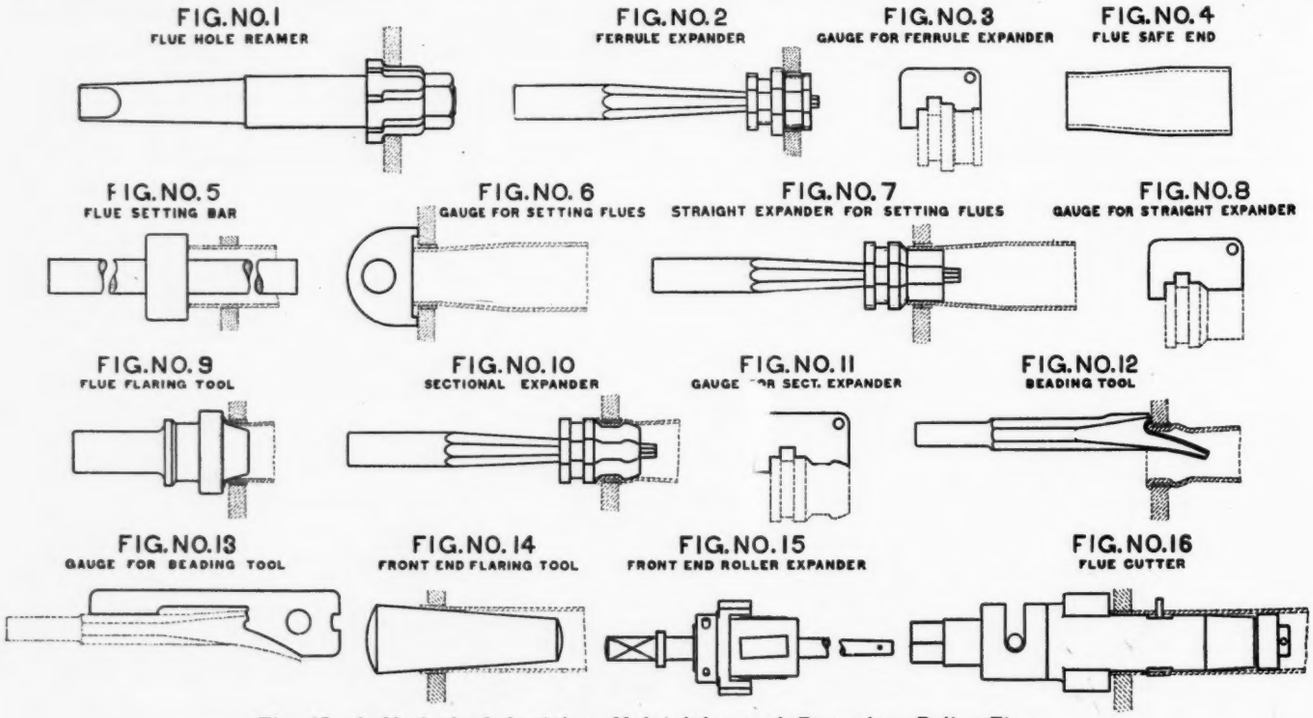


Fig. 15—A Method of Applying, Maintaining and Removing Boiler Flues.

16 is preferred, and the committee suggests this setting, except that the copper ferrules should be No. 13, .095 in. thick, instead of No. 16, .065 in. thick.

Circulation of Water.—The committee took up the question with the members whether any of them employed any special feature of design to facilitate circulation of water. It was found that no member has any special design for this purpose. Four members advise that they use baffle plates in the boiler shells, located ahead and rear of the dome. This is to prevent, as much as possible, the water from surging when making quick stops.

Seventeen members deliver the feed-water to the boiler in the first course on the horizontal center line. The distance from the front flue sheet varies; the minimum distance is 22 in. and the maximum 6 ft. Five members advise that they deliver feed-water to the boiler through the top as well as from the side. One of these members advises that they have never been able to find any particular improvement which the top check has over the side check. Two of these members prefer the water to be fed into the boiler from the top. Boilers having the checks on top of the boiler have a pan-shape deflector under the check valve which catches the water and prevents any direct stream of water falling on the top of the flues. One member advises that they deliver the feed-water in the first course on the horizontal center line and use a deflector plate placed a short distance away from the boiler course. This is to direct the water to the bottom without striking the tubes. Four members have an attachment on the inside of the injector check to deliver water upward away from the tubes. One member advises that in addition to circulating water from the horizontal line of the boiler they have some locomotives with the delivery pipe passing through the back head, extending from 3 ft. to 6 ft. from the front tube sheet, and the end of the pipe set to deliver water towards the side of the shell; the end of the pipe is submerged.

The committee has no recommendaton to make in regard to any particular location where the water is to be delivered to the boiler, as any of the above arrangements seem to give entire satisfaction.

Auxiliary Dome or Manhole Cover to Facilitate Interior Inspection of Boiler.—One member advises that they provide an auxiliary dome, or manhole, for interior inspection of boiler. The size of manhole is 15 in. in diameter, located a short distance ahead of the back flue sheet. This is submitted for consideration, as it makes inspection of the interior of the boiler possible without removing the throttle standpipe and dry pipe. One member of the Association is using larger dome in new construction to accomplish the same result.

Surface Blow-off Cocks.—Four members use surface blow-off cocks. One of these members has discontinued using them while the other two members, using surface blow-off cocks, have located them on a line with the second gage cock, and advise that they get good results from the use of both the blow-off cocks and surface blow-off cocks by getting rid of the mud and scale by blowing the boilers regularly. One of the members locates the surface cock on the left side of the boiler head just above crown sheet and is connected to a perforated pipe about 4 in. above crown sheet and extends to the front end of crown sheet and branches both ways to within 8 in. of sides of boiler and about 6 in. above flues. Perforated pipes lead from cross pipe nearly to front tube sheet. When properly used this device is of considerable value in cases of foaming. One of the members, who operates about 1,400 locomotives, advises that on certain engines in bad-water districts the Talmage type of blow-off is used.

The committee has no recommendation to make in regard to the number or where the blow-off cocks should be located. The number and location of blow-off cocks depends on the quality of water used.

Filling of Boilers.—One member advises that they have had a number of side sheets cracked by filling through blow-off cocks located in the water legs. They did not state whether they used cold or warm water. They are now filling through the blow-off cocks located in the barrel of the boiler. Another member advises that they have had considerable experience with sheets cracking from the filling through blow-off cocks with cold water. They now fill boilers through injectors when using cold water. It seems to be the censensus of opinion of the members that it is most advisable to fill the boilers from the blow-off cocks in the water leg, providing warm water is used. If cold water is used it should be filled through the valve on top of the boiler or through the injectors, and the committee recommends that this practice be followed out.

Washing Out and Filling Up of Locomotive Boilers.—The reports regarding washing out and filling up of locomotive boilers and the use of blow-off cocks were so at variance with what is generally considered good practice, the committee would strongly recommend the appointment of a special committee to report thereon.

Location of Fittings.—Gage cocks and lower column cock should be located so that they will not come directly back of gusset plate or stay angles, and not to be located directly over arch tubes.

The report is signed by D. R. MacBain (C. R. I. & P.) chairman; C. E. Chambers (C. of N. J.); T. W. Demarest (Penna.); F. H. Clark (B. & O.); R. E. Smith (A. C. L.); J. Snowden Bell and E. W. Pratt (C. & N. W.).

DISCUSSION.

F. F. Gaines (C. of Ga.): I think this is one of the most valuable reports that we have had submitted in a long time, and I am sure the association is under great obligations to the committee for their very thorough work. As regards the question of a large mud ring radius, it has been my experience that this is not altogether desirable. We have had some trouble with the large mud ring radius where we have not had it with the small one, and after having tried it we have gone back to the small radius. In regard to the question of arch tubes; I notice the general practice is to use tubes .18 in. thick. I would like to say that I have obtained better results from the .15 in. than I have from other types. Also concerning the radius of the flange in the back tube sheet; I found a smaller radius there gives better results, and after experimenting with a large radius, I have gone back to the small radius. I would also like to endorse the method of using sling stays referred to with the flexible arrangement. I also endorse the plate Z-1, as regards flue setting.

I also would like to call your attention to one other thing that there has not been much said on, in regard to the circulation of water. I find that, contrary to all theory on the subject, wide water legs in the fire box has not proven, according to all my tests and experiments, as good as the narrow water space, much better results being obtained from the narrow water space. In engines built exactly alike, in every respect, except one having a large water space, and the other a small water space, the small water space engine is a much freer steamer in every way. Of course, it is a little hard on the staybolts, but with the use of flexible staybolts, I think we are fully justified in using the smaller water space.

M. H. Haig (A. T. & S. F.): In the oil burning engines, a radial stay is being used which has a tapered head and no button head. It is screwed into the crown sheet within a short distance of the bottom of the tapered portion, and that end is then riveted over. The taper is 1⅜ in. in 12 in. The thread is 12 threads per inch (Whitworth standard). The oil burning service is a little harder on fire boxes than the coal burning service, and as this radial stay gives very satisfactory service in oil burning engines, there is every reason to believe it would be equally, if not more, satisfactory in coal burning locomotives.

It is the practice of one road that I know of, to apply 6 rows of button head stays at the center of the crown sheet for coal burning engines, and use the radial stay which I have explained, entirely on the oil burning fire boxes. I have referred to this radial stay and given these dimensions, as the matter was not included in the report of the committee. With regard to the mud ring, I also noticed that there was no reference in the report to a greater depth of mud ring immediately at the corners to provide for caulking. One railroad uses what you might call a heavy boss at each corner, which is about ¾ in. thicker than the remainder of the mud ring.

Reference is also made in the report to the O'Connor type of fire-box door. The road by which I am employed has applied that arrangement on all engines that have been built in the last few years, and it has given very satisfactory service. A request for information as to the performance of this door on the various divisions of the system has resulted in reports that the performance is very favorable. With regard to the large dome to facilitate entrance to the boiler to permit inspection, in my opinion it is a very commendable recommendation. In practice, the boiler inspection rule requires that the throttle must be removed, or that the information be given that an inspection is being made, as far as possible, without removing the throttle. If domes are made large enough to facilitate entering the boiler conveniently, I think that is a point which could be well taken up, to advantage. I mention that for the reason that rule has caused some confusion in certain districts with which I have been associated, and some of the boiler inspectors are not just fair as to how they shall make the report, and the Government inspectors are rather strong on that. I think that point could also be looked into with good advantage.

D. P. Kellogg (S. P.): We are using the same style of radial stay that Mr. Haig referred to, with good results, except that we use 1½ in. taper. We go a little further and use a thimble on the crown bar bolt, which goes up against the crown bar and eliminates the necessity of caulking into the crown

bolt. Lately we have been applying that without riveting, simply depending on the taper, and we have got good results.

The report speaks of the difficulty experienced from the flue sheet traveling up by reason of the expansion of the flues. In putting in a new fire-box we drop the crown sheet down, and try to make it half the distance we expect it to rise in service, thus dividing the amount of travel, giving it half the amount to start with, and allowing for the other half to bring it to slightly above the straight position.

W. E. Dunham (C. & N. W.): The committee mentions the .18 in. arch tubes. We have been doing some experimenting, using a No. 7 gage and a No. 10 gage arch tubes, both iron and steel tubes, but in the bad water districts of Minnesota and Dakota we find there is not much material difference in the two gages of tubes. The greatest trouble there, especially in South Dakota, is to keep the water in the tube. I do not just understand the reference where the committee makes a reference to the radius of the flange in the back tube sheet, and that 2 members had increased the radius from 7/8 in. to 2 in., and then have gone back to the 7/8 in. It would seem from reading the report that there was an improvement made by going to the 2 in. over the 7/8 in radius, and I do not quite understand why the members referred to should have returned to the use of the 7/8 in. radius.

In regard to the matter of radial stays with the button head: The committee seems to indicate that the use of hammered heads in the central rows at the top are not general. We considered that the use of the hammered head, especially at the forward end of the box, was entirely a matter of safety and ought to be generally used. In connection with the Federal inspection of the domes and inspection of the stays on the front flue sheet, I see that there is no recommendation brought out on that point, although the report mentions the use of an auxiliary dome or a manhole for the inspection of the boiler. That possibly could be taken care of. I have been thinking of locating an especially large water-washing plug near the front flue sheet, and at the top of some of our small boilers so that we can observe these stays.

Mr. Gaines: In reply to Mr. Dunham, I would like to say that the reason from going from the larger radius flue sheet to the smaller radius flue sheet was due to the trouble we had with the larger flue sheet cracking and breaking. Our experience showed that the smaller radius gives very much less trouble in this respect than the larger radius.

J. F. DeVoy (C. M. & St. P.): So far as my personal opinion is concerned, the report is about the best I have ever seen. I do not understand exactly now, even after Mr. Gaines has explained it, why he went to the smaller radius sheets, other than transferring the expansion which you naturally get in the large radius, back to the location between the rivets and the first sling-stay. It would simply transfer the expansion from one to the other and it might relieve the cracking in that way. With regard to what another member said relative to oil burning boilers receiving harder service than coal burning boilers, that is not our experience in the past year. In our first oil burning engines we did not protect the seams and the rivets. For the past year we have covered all the seams and all the rivets with brick so that there is not anything which is any more severe on the fire-box than there was in the coal burning locomotive, and the only suggestion that occurred to me in reading this report was possibly the fact that later on the committee could designate in some way a standard method of protecting an oil burning fire-box by the proper location of brick.

There is only one thing in regard to sling-stays in an oil burning locomotive; it is the button head. On the Chicago, Milwaukee & St. Paul we use a copper washer, only on the coal burning locomotive, and we still find that in our territory this is as good as any other method. In oil burning locomotives the button head is used altogether. I would like to see some attention given here to the distance from the belly of the boiler to the lower point of the mud ring.

W. J. Tollerton (C. R. I. & P.): I would like to call attention to Fig. 5; the scarfing of the seams and riveting the seams. We have been operating the scarfing of riveted seams for about 4 years, and we know that it does eliminate the flange cracking from rivet holes. By scarfing the seam down ½ the thickness, we have been able to run sheets 18 months without cracking at the rivet holes, and I believe it is a great advantage.

Mr. DeVoy: I want it understood that my remark as to the riveting of seams was directed entirely to oil burning locomotives, of which we have about 150, and did not in any way refer to a coal burning boiler.

S. L. Bean (A. C. L.): Concerning oil burning engines, I might say that we used the submerged seams with the present door sheet. As to the flue sheet, we tried the submerged for a short time, and it worked fine; but we have to work the flues so hard that a vertical expansion takes place, and as it goes up you encounter a greater defect. Your crown sheet cracks right across, immediately back of the flue sheet. With the door sheet it works fine where there is no working of flues to disturb it and it helps it wonderfully. One of the gentlemen spoke with reference to putting on some brick. That helps it, but it is desirable to get away from it, and we only use that to prolong weak boxes. We find that the button head stays will peel off in a year or so. We invented this taper head and slightly riveted it over, and now they last practically the life of the box without renewal. Occasionally we do have to renew some of them. We have extended the oil burning firebox period of service from about 18 months to a record as high as 7 years in heavy consolidation locomotives used in mountain service and in a bad water district. And I am free to recommend that taper radial stay. It will surely hold under all conditions, and I don't think it costs any more to apply than the button head. I think Mr. Kellogg will bear with me on that.

With reference to the doing away with the large flange in the flue sheet or bend, we find with a short bend that the metal was somewhat disturbed and a pitting took place much quicker. We also found that with the thimbles under these crown bars, the forward end pit immediately under the thimbles and destroyed the life of the firebox. We took them out and now find we prolong our boxes a great deal by patching. There is where the seam brick comes in pretty well. You can patch the top flange of a flue sheet with a submerged patch, and by using a light seam brick we sometimes get over a year's increased service at a slight expense.

E. W. Pratt (C. & N. W.): I would like to ask Mr. Bean if they use a thimble under the crown bars on their oil burning locomotives.

Mr. Bean: Three in each row. We do that in order to keep away from that burning.

J. A. Pilcher (N. & W.): I wish to say in connection with the matter of construction that we have been making some experiments with every wide water space, as much as 7 in., and it has been very favorable. We have been using it now for several years and applied it to something like 250 locomotives, and I understand from the reports that we have been getting, that it has decreased the stay-bolt renewal as well as increasing the circulation, and keeping the boilers clean around the mud ring. Of course, like most boilers on large locomotives, we have had some trouble in getting all of the depth to the front leg of the firebox that we would like. It seems to me the increase of the water space has been entirely favorable.

Mr. Gaines: I would like to ask some of the members who have had experience with oil burning locomotives, about how soon we should look for trouble when a coal burning engine has been changed to oil burning.

Mr. Kellogg: I will answer Mr. Gaines, that he will have no trouble until he gets out the button head that Mr. DeVoy said he was using already. I cannot use it. I would say that this method of reducing the flange is also very necessary. We want nothing projecting inside of an oil burning firebox that can possibly be prevented.

Mr. DeVoy: I absolutely agree with the last speaker, and perhaps he was mistaken. You cannot have anything projecting at all. We countersink all the rivets and the flange stay, as referred to here, with the taper, and a slight button head is what we use, getting away from as much projection as possible everywhere; so that in order not to confuse between our standard practice of the Chicago, Milwaukee & St. Paul, I call the other the button head. So, I thoroughly agree with you in that. There is but one way to do any transferring from a coal burning to an oil burning firebox; put on a piece of brick just as soon as possible. You can patch it just as easy as you can a coal burning boiler. And apply the brick to it and you won't have any trouble at all. It will repay you for many a failure.

W. J. Tollerton (C. R. I. & P.): I may say for Mr. Gaines' information, that you will have very little trouble with your sheets cracking behind your brick. The cracking will occur above the brick, and you will have much better satisfaction if you slip your brick out slightly outward; even on a vertical sheet it has a tendency to keep the brick in place. A little broken glass thrown on top of the brick will help you very much in your performance.

A. G. Trumbull (Erie): Our practices are very well covered by the report of the committee. However, I should say in regard to Fig. 10, that many of these stays have been submitted by railways that have very good water conditions.

The second one, for instance, could hardly have been better designed as a mud-catcher, if that had been the aim. We have used with considerable success the type of throat sheet stay shown on Plate T-1 of the Supplemental report, our idea being that it was rather incongruous to attempt to resist the influence of expansion by the use of a collared stay, and, as far as my observation goes, we have not had a single case of cracked

flue sheet where the crack is of any length, since we commenced to use a particular type of stay. I have been also interested in the standard method of setting flues as illustrated in Fig. 15, and it seems to me we might very well dispense with the flue-flaring tool and utilize, instead, the sectional expander which, as illustrated here, will answer every purpose in setting the flue, and also in turning the end of the flue over, so that it can be properly beaded. I also think we can very well use the sectional expander, instead of the ferrule expander here illustrated, thereby reducing the number of tools, and consequently the maintenance, and possibly enable us to follow up the practices in engine houses much better than we could with the number of tools that are here illustrated.

Mr. Pratt: As a member of this committee, I am of the impression that there was no report made by any of the members concerning the service of the Jacob Shupert fire-box or its design, and that is the way I can account for its omission in this report. This report is a résumé of the reports of the different railways that took the pains to give the committee the information they desired. I think it would well pay the designers of boilers to consider the suggestion of the committee with regard to length of flues, wherein it is rather modestly stated that the lengths of over 16 ft. be given careful consideration and when we obtain Prof. Goss's report of his evaporation efficiencies, as between the fire-box and the flues, I believe that that will even be more strongly brought to our notice. It is apparent from his preliminary report that the fire-box evaporation is from 50 to 54 per cent. of the entire boiler evaporation. Therefore, it may not be that there is very much obtained by the few feet additional length on the front of the flue, while there would be a great deal gained apparently by an increase in the fire-box by using the combustion chamber. I may not be correct, but it is my impression that more of the railways are doing away with the two holes than are going to the double fire doors.

Relative to the thickness of arch tubes, I believe the water conditions have more to do with the results obtained by the different members, one getting the best results from a heavy arch tube, and another with a light arch tube. On the Chicago & Northwestern road, where we have some pretty poor water and some divisions with treated water and pretty good water, we have found that in the latter case they recommended the light arch tubes, while in the poor water district they preferred the heavy arch tubes, and got better mileage out of it. We experimented with several locomotives making a gage or tram to indicate the upward movement of the top of the flange of the back flue sheet, due to repeated expansion, and in a locomotive with about 400 flues, I don't remember the diameter of the shell, we found that the top flanges of the flue sheet moved upward from ⅝ in. to ¾ in. during a year, with expansions approximately once every month. We tried the O'Connor fire-door flanges out very thoroughly before we adopted it as standard on the Northwestern, running engines with and without it in the same districts, especially poor water districts, and I found it to be quite an advantage. We have over 1,200 locomotives just equipped. In fact, we have nearly as many locomotives equipped with the O'Connor flange on the Northwestern roads as on all the other roads in the country combined. But the reports in the extremely bad water districts in the southwest and the extremely good water districts, where the trouble with the doors and door sheets was due to expansion and contraction, appears to be about the same. In applying this door to a new design where the staybolts are laid out as we would suggest, the nearest bolt on the door sheet side is from 7¼ in. to 8 in. from the edge of the door hole, which gives a much better expansion and contraction. We are new in the oil-burning business; we have less than 50 locomotives at present, equipped for burning oil; but we find that with the front-end burners, as they are being used by most of the oil-burning roads, the flame strikes the door sheet and gives more trouble than with the coal burning engines. With the expansion and contraction that is permitted in these door sheets, by means of this flange, the door lasts very much better than the ordinary type of door. In fact, we find that the large proportion of our engines that are in the boiler shop are receiving new flue sheets and side sheets and the door sheets require no attention whatever, either about the flange or about any part of the door sheet.

F. J. Harrison (B. R. & P.): I would like to ask the gentleman who has just spoken if he found any accumulation of mud about this door sheet?

Mr. Pratt: We did not. There appears to be a much better circulation around the door on account of the greatly enlarged water space, and more particularly because the staybolts are far away from the door; but I believe it is proper to put a wash-out plug above any door. We know there is more or less scale that falls down there and it is quite a distance from the wash-out plugs which go above the crown sheet, and it would be found quite an advantage to have a wash-out hole above any door, to wash it out.

Angus Sinclair: Taking the substance of all the reports on boiler construction that have been presented to this association, I think that this is the best one I have ever examined, and I think it is very creditable to the committee that they have made a synopsis of the whole tendency of progress in boiler construction, and everything that they have recommended seems to be in the right direction.

D. P. Kellogg (S. P.): To prevent accidents due to low water in the boiler we have endeavored to perfect an apparatus, which has proven satisfactory so far. It is operated by a difference in temperature, which is secured by entrapped water in a cup, and partially cooled to about 50 degs. lower in temperature than the water in the boiler. When the water falls to any prescribed limit, the man in charge of the locomotive sees the danger line, or steam enters and expands the mercury in the device which opens a steam valve, and causes an audible alarm, or controls the fire. In the case of an oil burning locomotive, it shuts off the fuel supply, and in the case of a coal burning locomotive it sprays the fire with a jet of water. There are about 40 of these devices in use on the Southern Pacific. At the present time they have proved quite satisfactory, and it is our expectation we will extend the application of them to a very large extent.

J. Snowden Bell: As a member of the committee, in considering the replies that were received from the roads to our circular of inquiry, I was surprised and disappointed at the comparatively little amount of information which we received on the subject of combustion chambers. Now, in view of the admitted superior evaporative efficiency of fire-boxes and heating surfaces, and the ability to attain it by the use of the combustion chamber, it has always seemed to me very desirable that they should be adopted unless there is some good reason to the contrary.

M. H. Haig (A. T. & S. F.): Most of the discussion has centered on the construction of the boiler. At the same time there has been more or less discussion during the entire convention with regard to economies. There is some reference in the report to the method of delivering feed water and I will refer to one arrangement by which water is delivered to a perforated pipe connected to each boiler check. the water coming out of these various perforations in the pipe falls on a plate above the tubes, and the claim is that cold water does not settle so readily at the back of the tubes. I would like to ask some of the members for an expression of experience with regard to that method of delivering feed water. One of these devices was placed on an engine on a western road 6 or 8 months ago, and the only report given so far was from one of the road foremen engines who has been following this engine. His claim is that the engine uses less fuel and less water, and at the same time he states there is a greater tendency for water to be lifted to the throttle. That latter feature, however, is a shortcoming that no doubt can be overcome.

C. E. Chambers (C. of N. J.): Mr. Bell raised the question of absence of information concerning combustion chambers. I presume all anthracite roads, nearly all, at any rate, at one time all used combustion chambers on their engines. There is no doubt at all as to the efficiency of such chambers in aiding combustion, and the aid to the steaming of the engine which follows when the combustion chamber is in good shape, thoroughly clean and the flues clean. However, the use of the combustion chamber means the drawing of the fire at least once a week, and the cleaning out of ashes accumulated behind the brick wall, and the boring out of several of the bottom rows of flues which naturally block up. There is another condition against it, it reduces the number of flues in the boiler, and we also naturally have a small circulation space between the bottom of the combustion chamber and the boiler shell. This requires close watching, if the water is at all bad, to keep it from blocking up. Eliminating these arguments against the combustion chamber, there is no question at all about the good you get from it, so that, after all, it is simply a matter of the conditions that will govern whether you will or will not have a combustion chamber.

A few years ago we changed from the combustion chamber, in several types of locomotives, when we were making renewals of the firebox, to the D-flue sheet type. We also had a number of boilers built with straight flue sheets, and as the boilers required new tubes, flue sheets, or throat sheets, we applied the D sheet, because of the short life we got from the straight flue sheet and the shallow firebox. I find an increase in the life of the D sheet of as much as 40 per cent.

I think Mr. Trumbull made some mention as to the number of tools we have designated for the purpose of applying the various sheets to the boiler. We, of course, attempted to indicate what we considered was good practice. My experience with the average engine house is that if you let the machinist

have his own way, his kit of tools wil consist of a pinch bar, a hammer, and a chisel, and we have designated here what we think is good practice, and have defined the use of suitable tools for the different purposes provided.

One of the members spoke of going to the extent of 7 in. in the water space in the legs of boilers. I do not know how long he has used that space, or how closely he has watched the operation of it, but it seems to me you get a very sluggish boiler with 7-in. water space, and while it may not plug up, I cannot agree to the efficiency of such a spacing. My idea is, and always has been, to use as little space as possible, and keep it clean, if you want to get a good and efficient boiler. As to the scarfing of seams in firebox sheets, that has been tested out very thoroughly on the Central of New Jersey, and, in our opinion, there is no question about the good results obtained.

F. F. Gaines (C. of Ga.): In reply to Mr. Bell would say that my experience originally with the combustion chamber is very similar to that of Mr. Chambers. At one time I was in the anthracite district and was pretty well acquainted with the combustion chamber as it then existed. I have been a little hesitant about saying much about the thing but I would like to refer to Fig. 2 of the report and answer some of the objections Mr. Chambers has made to the combustion chamber and show that these can be overcome. For instance, you can completely remove at any time, any sediment, sparks, etc., deposited in the combustion chamber. You also get rid of the water legs, but do not cut down the number of flues. I would further say that there is an absolute coal economy of about 15 per cent., which was determined on very carefully and thoroughly conducted tests. I would also say that in the matter of flue economy, it is very much more than that. Engines in the district where the first engine was equipped with this combustion chamber, ordinarily make about 25,000 to 30,000 miles, and the first engine so equipped has now made over 110,000 miles, and during the time that it has been making this mileage, we have not had a request from the engineer to blow the flues. The engine has been in the shop twice for tire turning and the flues were examined and probably blown out, but the flues have not been blown out in the engine house, as far as I have been able to ascertain.

It also does another thing, with the soft coal engine it would not be so noticeable as with an anthracite engine, but it eliminates to a large extent, sparks and smoke. An engine with this device properly applied will not emit any black smoke, and but a minimum of brown smoke, and the sparks are noticeably absent. The amount of cinders found in the front end is about 25 per cent. of what you find in the ordinary engine, although we are using in the front end what you would style a self-cleaning front end.

We also found in our short experience, not enough to pass on the matter definitely, as we have only had the superheater engines in connection with the combustion chambers for 6 weeks, and have not found it necessary to blow out the superheater flues, that there is very little trouble with the flues. We have yet to find any indication of these flues stopping up or giving trouble, as they have done in many cases when soft coal is used. In regard to the question of the maintenance, the fact that the engine has made this large mileage as against the ordinary mileage, answers that point thoroughly. We also got rid of another point Mr. Chambers referred to; that is the multiplicity of seams due to the ordinary type of combustion chamber; you have no more seams than with the rest of the fire-box; you simply have a longer fire-box, which gives a greater fire-box heating surface.

D. H. Deeter (P. & R.): When we first started in designing the wide fire-box we had the old sloping baffle sheet at the top. After having 75 of these locomotives, we found with the amount of service that was required of the engines, they would not carry the water properly. Our combustion chambers were 22 in. in length at that time. The depth from the bottom of the combustion chamber to the bottom of the barrel at the throat sheet was about 7 in. We had tried various sizes of flanges at the throat sheet from 1½ in. up to 3 in., but mud would collect at that point. We had quite a little trouble with the bottom of the combustion chamber becoming blistered and burning out, and in 2 or 3 years becoming detached. By removing about 8 of the flues every 6 months or a year, in addition to 2 or 3 of the bars, that trouble was all eliminated. This is a small matter compared with the amount of saving of fuel.

After trying these engines for about 15 years, we put on the straight wrapper sheets, and found that we could carry our water more easily and steadily over the road, also obtaining better circulation. Now, in my estimation, if we could lower the depth of the sheet three or four inches more than it is it would be an advantage, as Mr. Gaines says, but from the fact of the construction of the wide fire-box, it is really impossible to go down any further than we are now, from the fact that you cannot get rid of the ashes so readily. They seem to clog up along the side.

Regarding the trouble with the bottom flues in these combustion chambers, we are losing sight of the fact that it is not altogether on account of the construction. Years ago it was very seldom that we would remove the flues. A good deal of the trouble can be laid to the fireman. In previous days he was more careful and we should teach the fireman to properly fire his engine. Furthermore, we have found that the fireman is more or less anxious to fire with both fire doors open at one time, which is very hard on the fire-box. We have cases where we do not clean out our combustion chambers on our fast freight engines once in 2 weeks, but on our high-speed locomotives we are really compelled, as Mr. Chambers says, to clean out the chambers twice a week.

We find that a 2 in. flue is the most serviceable flue that we can have for a wide fire-box locomotive with a combustion chamber. We have tried all sizes of flues, from 1¼ in. to 2½ in. We changed from the combustion chamber about 10 years ago on our D-5 engines to what we term a combination flue sheet. In my experience in handling these engines I found our principal difficulty was to keep these combination sheets stayed properly at the bottom or close to the firing line. The life of these combination sheets ranges from about 2½ years to 4 years. We have discarded quite a few of them and gone back to the combustion chamber, and I find the combustion chamber is economical as to fuel and the life of the fire-box is about 8 years as compared to 4 years in the case of the straight sheet.

Mr. Chambers: For fear that the members may think from the remarks I made that we have discontinued entirely the combustion chamber. I wish to say that at the present time we are building engines both with the combustion chamber and without, largely governed by the service they are going into.

F. T. Slayton (Virginian): I should like to ask if any member present has had experience with the welding of flues to the flue sheet. Several speakers have referred to the growing of the flue sheets, that is, the expanding of the flue sheet in an upward direction, which must be due to rapid working of the flues, with Prosser and roller tools, which not only has a tendency to cause cracking of sheets, but must necessarily take the pressure off the first staybolts next to the seams, thus transferring the load to the next row of stays, and so on, thus doing away really with the use of the first row or rows of stays. It seems to me that if we could avoid this excessive working of flues, we would overcome that trouble.

I understand some of our members have had experience with welding in flues for a year or more. I recently made a test of this kind which has proven very favorable thus far, but I do not know what I am going to run up against later. About 3½ months ago, I took an engine which was in service, where it was compelled to take brackish water entirely from one tank, and had extremely hard service on account of pushing cars over a hump, and then drifting into a yard where it was worked to its full capacity for probably 30 minutes, then drifting around for an hour. The engine got into such shape that it was necessary to "kill" it practically every day to work the flues. The engine was supposed to work day and night. We welded in the flues and since that time we have had no trouble whatever. This was an engine in which the flues were all set in the regular way, and the welding-in simply consisted in sealing the joint between the bead and the flue sheet. By making some experiments with a section of flue sheet with the same welding process, we found we could get a better job by simply letting the tube project through the sheet, the same as for rolling and beading, and then fill in between the end of the tube and the flue sheet, at an angle of about 45 degs. It made a neater job. We also tried belling out the end of the flue and welding in a similar way, but found there was a tendency to burn off the edges of the end of the tube, and that we could get a better job by allowing the tube to extend through straight. This engine is now in the shop for general overhauling, but we are not removing the flues, as they did not give us any trouble, and we wish to continue the experiment.

I next welded in the flues of a Mikado engine having a tractive effort of 55,900 lb., hauling 100-car trains of 7,600 tons in regular service, and welded the flues as well as the fire-box seams of this engine. This engine remained in that service until about a month ago when it was put in lighter service on the mountain, and the engine comes to the terminals only for wash-outs. This engine has given no trouble from leaks in the fire-box, although previous to the welding of the tubes we had had considerable trouble from leaky tubes. In the case of the road engine, there were also about

40 fire cracks in flanges or sheets which were welded successfully.

Thos. Roope (C. B. & Q.): We have only one class of power in which we have welded our flues and that is the Mallet, equipped with double boilers. When we discontinued using the hot boiler and feed water heater and obtained steam from both boilers, we found it necessary to weld the top flues in the front boilers. We were not able to keep them tight in any other way. The engine has been running now for about one year, and up to the present time has been successful.

C. A. Seley (C. R. I. & P.): I do not believe that this committee should be criticised at all for matters omitted from the report. They have given a compendium of information of great practical value of the practice of the railroads in regard to the design and use of boilers, as contained in the responses to the committee's circular of inquiry, which was very voluminous, as members will remember, no doubt, and the committee has framed up a very useful and valuable report. I think we are exceptionally fortunate in having this report for our proceedings, and as a guide in our practice.

Prof. W. F. M. Goss: I have prepared no discussion of this paper, although it is one which interests me very much. I am impressed both with the report of the committee and with the discussion that has been based upon it, with the fact that in very many matters of detail entering into the construction of a steam boiler, much depends upon related details, and it seems to me that the conclusions of the various members of the association responding to the requests of the committee for information, need to be very carefully analyzed before they are in all cases safe as guides to practice. I think the one statement which has been brought out in this discussion, which interested me most, is that of Mr. Gaines, and some others, which seems to advocate a narrowing of the water legs of the boiler. I had rather the feeling that progress in the design of locomotive boilers during the last 15 or 20 years had been expressed as much by a tendency to give greater width to the water legs as by any other tendency, and so I must confess to a great deal of surprise to find there are some who feel that that movement has been carried too far.

Of course, our problems in locomotive design and maintenance change from year to year as practice leads us into new fields. If we look back into the development of the last 25 years, we shall have ample evidence of that fact. When our boilers were small, most of the railways were using the crown bar form of construction, and to my mind that form of construction is necessarily associated with the small boiler of a good many years ago. There is no chance, as it seems to me, to enter into a discussion of the crown-bar type as applied to our modern large boilers. We continued in the use of the crown bar until the forces to be sustained by the crown bar became too great for satisfactory treatment through that form of design, and then we went to another form, the radial stay, and between, perhaps, the crown bar and the full fruition of the radial stay, came the Belpaire boiler, and I take it that the railways for many years past, the past decade anyway, have been devoting themselves pretty largely to the perfection of the radial-stay, type of boiler, and the result is a highly perfected design, in the perfection of details of which we are pretty largely engaged at the present time.

But now the radial stay boiler has grown to dimensions undreamed of over 10 years ago in general locomotive practice, and there is no doubt in my mind but the radial stay boiler is going to continue to grow, and that fire-boxes will, in one form or another, continue to increase in size, and what are the problems of the future with reference to such a possible development? That is the large question to look forward to in considering the tendencies in locomotive boiler design, and keeping that in mind it seems to me that some of the propositions which are now being put forth, especially that which has been referred to as represented by the Jacobs-Shupert type of boiler becomes, in the light of possibility of future practice, and of the increasing demands of every-day practice, a matter of very great significance and interest.

G. H. Baker: I wish that the committee could be continued, or that another committee should take up a branch of the subject which has not been dwelt on in the present report. After a boiler is constructed, it must be operated. During the 20 years I have been a member of this association, there has never been a committee, I believe, that considered the subject of the management of locomotive boilers and their operation, although two of the speakers here this morning, have brought in the importance of the human element—the engineman and the fireman.

F. F. Gaines: I move that the discussion be closed, and I would also like to move the suggestion relative to washing out and cleaning locomotive boilers. I think that is a good subject.

E. W. Pratt: It seems as though it would be in line with the recommendation of the committee, if the new work of the committee could be outlined as suggested by Mr. Baker, as well, and perhaps the title of the work which the committee would report on would be operation, maintenance and repairs of locomotive boilers.

The motion was carried with the amendment.

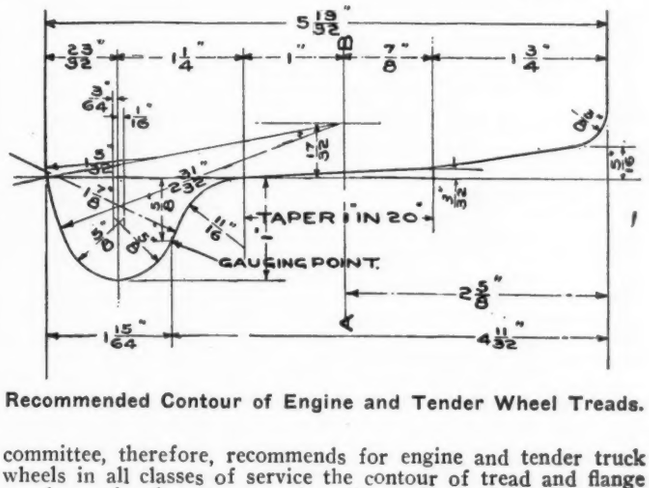
CONTOUR OF TIRES.

The committee on contour of tires has been instructed to look into the various points brought out in the discussion at the last convention and, if possible, recommend a contour of tire that would be most economical in all services; also, recommend a minimum thickness of flange for re-turned tires. The discussion at the 1911 convention was confined to the proposed reduction in height of flange from 1⅛ in. to 1 in., the taper of tread, and the question of limit of flange thickness of less than 15/16-in.

After considering the replies received to a circular of inquiry and such other data as were available, the committee is very

W. C. A. HENRY,
Chairman, Committee on Contour of Tires.

strongly of the opinion that the M. C. B. recommended contour of tread and flange for steel wheels should be used for engine and tender truck wheels. To a very large extent in ordering wheels it is not specified whether for tender trucks or cars, no distinction being made as between the two. It is of distinct advantage to the railways to keep down the number of standards manufactured as insuring more prompt filling of orders and a smaller stock on hand at their own ships. The



Recommended Contour of Engine and Tender Wheel Treads.

committee, therefore, recommends for engine and tender truck wheels in all classes of service the contour of tread and flange as shown in the accompanying illustration. This contour is the same as will be recommended to the M. C. B. Association in June, 1912, and differs from the present M. C. B. recommended contour in that additional metal has been added to the back of the flange, making the contour of the flange identical

with the flange for cast-iron wheels. This thickening of the flange was recommended with the view of increasing the life of the wheel, as many steel wheels are now withdrawn from service due to thin flange. Replies received from the manufacturers of steel wheels indicate that about 80 per cent. of the engine truck and 95 per cent. of the tender truck wheels manufactured during the past year are of the 1909 M. C. B. recommended contour.

In driving-wheel service the conditions are somewhat different, as the brake shoes generally used are recessed for the flange, and also opposite that part of the tread coming in contact with the rail. This tends to keep down the height of flanges and retards channeling of tread. On account of the general opposition to any reduction in flange height of driving wheels in road service and the fact that the present A. R. M. M. A. standard contour of tread is so nearly like the M. C. B. 1909 contour, the committee does not feel justified in recommending, at the present time, any change from the present contour, for driving and trailing wheels of locomotive in road service. As a matter of information, we wish to add that while practically all roads are using a contour of driving-wheel tire approximating the A. R. M. M. A. standard, almost all are deviating in some particular.

In the case of switching locomotives it is felt that a flange one inch in height is perfectly safe and will be more satisfactory than the present standard, as a greater mileage can be made with the shorter flange before reaching an objectionable height. As has been previously mentioned, the A. R. M. M. A. and M. C. B. contours of tread being so nearly alike, it was felt unwise to establish a new contour having the M. C. B. flange and A. R. M. M. A. tread, and we, therefore, recommend the contour shown in the illustration for driving-wheel tires in shifting service.

The six widths of flanged tires shown on Sheet 1 of the standards are, in the committee's opinion, entirely unnecessary, and we would recommend that one width be shown; namely 5½ in. In the case of plain tires, three sizes as recommended last year are sufficient; the two sizes 6¼ in. and 6¾ in. to be eliminated.

As concerns condemning thickness of flange below 15/16 in., after carefully considering the replies received and all information available, the committee can not see its way clear to recommend flanges of wheels under locomotives and tenders being allowed to remain in service when worn below this limit.

The committee's recommendations, therefore, are as follows:

RECOMMENDATIONS.

Engine truck wheels, contour as shown in the accompanying illustration.

Tender truck wheels, contour as shown in the accompanying illustration.

Flanged driving-wheels and trailing-wheels of locomotives in road service, present A. R. M. M. A. standard of 5½ in. in width.

Flanged driving-wheels in shifting service to be as shown in the accompanying illustration.

Plain tires, present A. R. M. M. A. standard, three widths, 6 in., 6½ in. and 7 in.

Condemning limit of thickness of flange, 15/16 in.

The report is signed by:—W. C. A. Henry (Penna.), chairman; J. A. Pilcher (N. & W.); O. C. Cromwell (B. & O.); O. M. Foster (L. S. & M. S.); H. C. Oviatt (N. Y., N. H. & H.) and G. W. Seidel (C. R. I. P.).

DISCUSSION.

E. W. Pratt (C. & N. W.): I do not wish to find any fault with the contour of tires as shown in the illustration, but we on the Northwestern road think there is an extra amount of time spent in turning driving wheel and trailer tires to get the double taper, and we do not gain anything by it; that if the taper is continued out to the outer side of the tire, and a good big corner taken off, we gain the same results and save a good deal of time in turning. The committee has reported on the subject as called for by the title of the committee, but it was suggested last year, and I may have been partially responsible for the suggestion—that in re-turning tires there be some minimum flange allowance. I want to say that I was impressed very strongly and heard other members express themselves similarly when we went across the Boardwalk here last summer and saw a modern lathe turning off metal by inches, almost, to get a full-sized flange, and after they turned down to a full-sized flange, they applied a contour tool and shaved the flanges three or four times around, after that. That is a fine demonstration of what a strong tool will do, but I do not believe that is what we are after, if it is our desire to save our employer's money. I hesitate to say how much of a telltale, as we call it, we can leave on a flange and still have it safe. I am confident we can leave some and in many cases save from any amount up to a half inch of the metal in re-turned tires. We have a gage, and of course we should not allow our tires to get into such shape, that our flanges are so sharp that we will have to turn them ¾ in., or anything approaching that, but we might as well be honest, and say that these conditions do come to us, and if it is possible, I think we ought to save some of that excessive turning, and I believe it is safe to do it. There is a wide variation between this flange shown in the illustration, which measures from the throat across to the vertical inside of the tire 1¼ in. plus $^{23}/_{32}$ in., nearly 2 in., and when the tire is worn to its limit, it is $^{15}/_{16}$ in. Is there not some compromise between $^{15}/_{16}$ in. and 2 in., which makes the wheel safe to run?

F. F. Gaines (C. of Ga.): I would answer Mr. Pratt by saying, that some years ago I had some very careful records kept on the cost of turning steel-tired wheels, and what was a good limit to allow before removing them for turning them, and as a result of that investigation we found it was money thrown away to run them to $^{15}/_{16}$-in. thickness; in other words, when your tire commenced to wear on your flange, the best thing to do was to take it up and turn it, and not wait until it got to $^{15}/_{16}$-in. thickness, and if you kept a record going over the period of a few years, you would find that you will surely save metal by that method of handling.

Now, there is another important point in which I agree with the recommendations of the committee, and yet it is not entirely disposed of and that is the height of flange. Last year after our discussion on this subject, I went home and started out by having the tires on one of our road engines turned up with a 1-in. high flange, to start with. I took a switch engine and turned the tire on that engine to a ⅞ in. height of flange. These engines have been running during the past year, come and go, and we do not know they are on the road any more than any other engines we have. They have not been derailed, and nothing else has happened to them. I do not say we have got to the point where I would recommend using these flanges, but I would recommend that some more of the roads make these experiments and see if it is a possible thing to adopt 1 in. height of flange on our freight engines, and also ⅞ in. for the switch engines, because, if we can do this with safety, it will be desirable to save a lot of metal on the tire.

M. H. Haig (A. T. & S. F.): While I hesitate to question the contour outlined by the committee, I would like to point out a feature which is along the same line, in connection with which we are wasting a certain amount of metal, and which has also an undesirable effect on the rail. The recommendation is a taper of 1 in. in 20 in. for the tread of the tire. I understand that taper was originally based on the desirability of having a small portion, or a small diameter of one wheel on one rail of a curve, while there was a larger diameter of wheel on the other rail. That may hold in some cases, but not always. For instance, if the leading truck leads the front drivers as it should, there are times when the flange of the leading driver is drawn to the inner rail in rounding a curve, and in the matter of a long wheel base, the front driver may be against the outer rail, and the flange of the other drive against the inner rail. However, after an engine has been in service for some time, the tread of the tire is worn to a certain extent, to the shape of the rail, and there is not the cone shape on the tire. I believe, therefore, that it is better to endeavor to form a contour based on the shape which a tire tends to take after it has been in service, and that is certainly more nearly a cylindrical shape than a conical shape. The cylindrical shape of tire has a larger bearing area on the rail, and therefore does not subject the tire to the same stresses of the metal as when there is a smaller bearing area on the rail. A new contour of conical shape tends to bear on what you might call the near edge of the rail, whereas a cylindrical or flat tire will bear more essentially on the rail above the web. The taper of the side of the tire shown for a distance of 1¾ in. will be sufficient to clear the various frogs and other obstructions along the line and will also tend to obviate for some time the shoulder which forms after the tread has been worn to some depth by the rail. Some of the manufacturers of locomotives, unless specified otherwise by the railways purchasing locomotives, will turn new tires with a cylindrical thread and not with a conical thread, and I feel that the cylindrical thread is more economical in the amount of metal turned off as well as in the effect upon the rail.

Robt. Patterson (G. T.): I am not any more convinced this year than I was last year that we should turn our driving tires taper. I think the explanation which the committee has given in regard to tender and engine tires and tires for cars is all right. Where wheels are turned up in the same shop both for the car department and engine repairs, I think that is desirable. We, of course, run our departments entirely separately, and it is not necessary to follow the same plan in turning tires for locomotive work as for car work. Consequently we don't see any reason why we should turn

our tires taper for locomotive work. I have heard no explanation yet of why we should turn our driving tires taper except at the extreme edge. How long does that taper last on the tires after the engines are put out? You can turn them more rapidly. You can make a better job of it. Why turn them taper. As I mentioned before, the road I am representing, we invented that practice 35 years ago. What advantage is there in it? I have yet to hear of an advantage in driving tires being turned taper. It is quicker done. You can make a better job of it. You don't require an expert machinist on the lathe to turn them, and it is only a month or so when the tire becomes worn.

W. C. A. Henry (Penna. Lines): In regard to the question of economical limit, I wish to say that that was discussed by the committee, and they felt that they varied with the different conditions of power between driving wheels and other wheels, and the conditions of service and demand for power and facilities for doing the work, that it was absolutely impossible to recommend a limit that would have any meaning at all. We felt that all we could do was to recommend an extreme limit of thinness. As regards the question of the taper of the tread, I think years ago it was a very general practice to have a portion of the tread cylindrical or very nearly so, and it was often advisable to give the tread some taper, so that the tendency would be for the flange to get away from the rail. While it is true that that original taper depreciates within a short time, it seems to start the wheels wearing properly, and a tread that has that to start with will show a longer flange life than the cylindrical. There seems to be some misunderstanding with regard to the taper of the tread. Many roads apparently have examined the diagram in that book, as indicating 1 in. from the fillet to the base of the flange. The tread is cylindrical. The diagram is very small and the lines run together. As a matter of fact, in 1908, the present contour was adopted, and that was a 1907 M. C. B. contour, which is a taper of one in twenty, commencing from the fillet to the base of the flange.

C. E. Chambers (C. of N. J.): I thoroughly appreciate the remarks made of the production of a flange by turning the tire taper. I am going to ask Mr. Pratt if he has had any experience or trouble with cut flanges, where the tires are straight or nearly so, and where the taper was used at the start. I find that very much depends upon the life of the tire, whether it starts right. The making of a slight taper gives the tire the benefit of going around a slight curve, by making the inside a trifle smaller than the outside, and the greater the curve, the wider track gage naturally gives it the advantage of a still greater taper. As to the turning of full flanges, I think there are several classes of service that you could save your company actual money in, by not trying to build up a full flange on all wheels. It costs very little to remove the tires. For instance, on an 8 driver engine changing those which may have become short, the front and back tires to the middle wheels, you can start your engine out again and it runs just the same and just as long as if they were all full flanges. If it comes down to a matter of engines running 75 to 90 m. p. h., you don't have to stop to consider metal.

F. J. Harrison (B. R. & P.): I would like to state that we have been running tires since the last convention with an inch flange. In fact, we are turning everything with a flange, 1-in. high, and if a tender wheel runs with a 1-in. flange, I don"t see why an engine wheel won't run with a 1-in. flange. I don't believe there are very many representatives in this room to-day that are running with driving tires down to a ¾-in. flange, and I think a good deal of attention ought to be given to the thickness of the flanges, with the heavy powers we are getting to-day. That seems to be the trouble with our road.

E. A. Miller (N. Y. C. & St. L.): I think perhaps the conditions under which engines work has something to do with the flange. I remember at one time we went to a 1-in. flange for driving wheels, when Mr. McKenzie was superintendent of motive power, whom I was working under, and we changed them to the 1⅛ in. flange, although we have continued for many years to make the switch engine driving wheel tire flanges 1 in. During the time that Mr. Gilmore was Superintendent of Motive Power of our road, he ordered those on switch engines to be changed to ⅞ in. flange, and we were not able to run our switch engines successfully with that height of flange, we had trouble from derailment, and we went back to the 1-in. flange. I believe that we should carefully watch the brake shoes to see that the wear is proper on the face of the tread, and that they are not unduly affecting the flange; that is as important as the exact taper that is given when the tires go into service.

If any of the roads so far neglect the flanges as to allow them to get bent, we will have to do penance for that by turning off the tread in order to get a suitable flange.

John Tonge (M. & St. L.): I always found that with engines properly squared, there was no difficulty with the flange wear, none whatever. They would keep equal on the flange right along, but when you come to a 10-wheel engine, it is quite different. You have got a long distance from your front wheel to your tread, and unless you keep your truck up, which, under some conditions, it is not always advisable to do, you are going to suffer, and my best advice on that is to put flanges on all wheels, keep away from the blind tires.

Mr. Pratt: I must have been misunderstood if it was thought that I was suggesting a flat tread. My suggestion was and it is our practice, to use a uniform taper. Instead of setting two tapers on the lathe, we set a 1 in. in 20 in. taper and run it out and take a good big chunk off the outside corner. With regard to the height of flange, about 2 or 3 years ago on the Northwestern, we decided to use a ⅞-in. flange on switch engines. We had been using a ⅞-in. flange on narrow gage engines for several years. The narrow gage speed limit is very low. We had no trouble from derailment, and we adopted that for switch engines, and found that we had apparently a good many more derailments. I believe if you will refer to the illustration that I can explain to your satisfaction why we have more trouble with that lower flange. The radii at the top of the flange is ⅝ in., and the centers are located just about the same as with a ⅞-in., a 1-in. or a 1⅛-in. flange. There is a radius shown as 1⅞ in. which connects the radius at the throat and the radius at the top of the flange. There is no center point for that circle. It is the intersection between the tangents to the other two circles. Now, if you lower your flange from 1⅛ in. down to 1 in., or down to ⅞ in., that arc with the 1⅞ in. radius becomes very much more flat. Instead of standing somewhere near vertical, it is very flat, and from careful observation we found that in switching around the yards with trucks, if they have any height of flange, they frequently crawl up the rail and drop back, especially going around sharp turns. And when we had that ⅞-in. flange, this arc of the circle of which I spoke was so nearly flat that the wheel kept on going up and over.

D. J. Redding (P. & L. E.): I confirm what Mr. Pratt has just said. We had an experience along the same lines. I think it is entirely due to the fact that the top of the flange is entirely too flat. We use 1-in. flanges on all freight engines in the yard, and have no trouble at all. If you get below that, you are going to run into trouble.

C. E. Chambers (C. of N. J.): The gentleman said something about the thickness of the tire in heavy service. I would like to know as to what he had reference to.

F. I. Harrison (B. R. & P.): In reply to Mr. Chamberr' remark, the thickness of the tire we had up to about 2 years ago was about 1½ in., and from that it went to 1¾ in., now we are getting to 2⅛ in.

Mr. Tonge: I don't know as there is anything you can save money in faster than you can by taking care of a tire, even if it is only one tire. Look at the increase of mileage you are getting out of your tires; and I don't care how you are cramped for engine power or anything of that kind, there is no excuse to give for that neglect. Now, you take the engine trucks, for instance. I have seen men change a pair of engine truck wheels in 20 minutes. What would be the use of allowing that flange to get worse so as to take off ⅛ in. Think of all the miles of wear you are taking off and the money out of the pockets of the company you talk so much about that you want to save.

It was moved and carried that the report be accepted, and that the recommendations be submitted to letter ballot.

INCREASED POWER OBTAINED WITH SUPERHEAT.*

We regret that we are unable at this time to make a full report to this convention upon the results obtained on the Purdue locomotive in regard to the increased power obtained with superheated as compared with the maximum power obtained with saturated steam. This is due to the fact that laboratory conditions were such that all the tests of the series could not be completed until so late a date that sufficient time was not available to make a full report.

It was thought worth while, however, to make some statement in regard to the progress of the work, and, in a general way, to indicate to what extent the power of the locomotive was increased by the installation of a Schmidt superheater, which gives a rather high degree of superheat.

It will be remembered that the work reported upon the last three years was a comparison between the efficiency of the locomotive when using first, saturated steam, and then superheated steam while developing approximately the same amount of power under both conditions. When the maximum power

*Individual paper by C. H. Benjamin, Dean of the Schools of Engineering, and Louis E. Endsley, Professor of Railway Mechanical Engineering, Purdue University, Lafayette, Indiana.

was obtained upon the locomotive while using saturated steam, it required the burning of from 120 to 130 lbs. of coal per square foot of grate area per hour, whereas when superheated steam was used, and when approximately the same power was developed, only from 85 to 90 lbs. of coal per square foot of grate area were burned. This difference in the amount of coal burned while operating with saturated and superheated steam, respectively, is due to the fact that about 25 per cent. saving was made in the amount of coal burned.

The work this year has consisted in increasing the power by increasing the cut-off by small increments in an endeavor to burn the same amount of coal per square foot of grate area per hour, as was done while using saturated steam. While we have not up to this time increased the cut-off to such an extent as to make this possible, it is apparent that there will be no great difficulty in burning the same amount of coal. When these tests are completed, it can then be determined to what extent the power has been increased and by what amount the efficiency has been affected. It is evident that if this increase in the amount of coal burned can be effected without decreasing the efficiency of the locomotive, the per cent. of gain in power will be even greater than the per cent. of gain in the efficiency of the locomotive when using superheated steam than when using saturated steam. The tests made so far, however, indicate that there is a slight decrease in efficiency with increased burning of coal, so that a gain of not more than 20 or 25 per cent. in power may be anticipated.

After presenting the paper, Professor Benjamin spoke as follows: "Since this bald statement was made, the tests in the laboratory have been carried far enough to indicate some rather interesting things; for one thing, the efficiency of the cylinder due to the increased cut-off. The increased cut-off, being rather high, has materially decreased, and instead of getting for a quarter of the coal saving an increase of power of 33⅓ per cent., we are only getting an increase of power of some 16 per cent. That is, the efficiency of the cylinder as a separate unit, has decreased almost 16 per cent. The increase of steam necessary to develop a horse-power has gone up about 15 per cent., due to an increase in cut-off of from 45 per cent. in a saturated engine to 70 per cent. in a superheated engine, using the same amount of coal. This increase has been brought about by dropping the reverse lever down until we are running on notches amounting to about 5 per cent. for each notch and we are gaining a cut-off of 14 in. When we get up to the 70 per cent cut-off, we are not getting the efficiency out of our steam. What we are now planning to do is to finish this series of tests with the same sized cylinder and then to increase the size of the cylinder to an amount which will give us the same cut-off with a superheated engine that we have with a saturated engine. This, figured on a basis of 45 per cent. cut-off, will require your cylinders to increase from 16 in. in diameter to about 21 in., the engine now being a 16-in. x 24-in. cylinder. Of course, if this increased size of cylinders should be carried out on your engines, without decreasing your boiler, you would have a very slippery engine, but we are not interested in the slipperiness of the engine, because at the speed at which we are running, it is not necessary to figure on the engine slipping, because the tractive power will not be over ⅛ of the weight of the drivers. The efficiency of the cylinders at 160-lb. to 200-lb. pressure, is developing practically the same, so that we can decrease our pressure to 160 lb. and get the same drawing power with a superheated engine that we would get at 200-lb. pressure if we had a saturated engine. We hope next year to make a full report as to just what we can get out of the larger cylinders.

Paul H. Brangs: In an article by E. D. Dreyfus, in the April, 1912, issue of the *Electric Journal* the decrease in the turbine water rate due to the use of superheated steam is given as follows: 50 deg. superheat, 5 per cent.; 100 deg. superheat, 10 per cent.; 150 deg. superheat, 14 per cent. A paper entitled "Recent Developments in Steam Turbine Practice," by K. Baumann, read before the Manchester section of the Institution of Electrical Engineers, January 16, 1912, gives the following figures: 0 to 100 deg., 1 per cent. improvement on the steam consumption for every 100 deg. F.; 100 deg. to 200 deg. superheat, 1 per cent. improvement of steam consumption for every 12 deg. F. This paper also brings out another important point, viz.: that the efficiency increases considerably with increase in superheat the following figures being given: For 100 deg. superheat 2.5 per cent. better efficiency, and 6.75 per cent. better efficiency for 200 deg. superheat.

The improvement in steam consumption and turbine efficiency given above due to the use of superheat, are compared to the efficiency and steam consumption with dry saturated steam. Ordinarily, however, steam, supposedly dry, will contain a small amount of moisture which causes a reduction in efficiency. According to the paper referred to above, the efficiency will change 1 per cent. for each 1 per cent. variation in wetness, and therefore steam consumption measured as condensed water will be 2 per cent. higher for each 1 per cent. increase in moisture. With reciprocating engines, the presence of moisture in the steam has a still greater detrimental effect as it greatly augments cylinder condensation. For this reason increase in economy of from 12 to 20 per cent. is not uncommon with low superheating of from 40 deg. to 100 deg. F.

The saving in coal consumption, due to the use of superheated steam is not as large as the percentage saving in steam consumption. 100 deg. superheat will reduce the steam consumption of a turbine, say, 10 per cent. This means that instead of 1 lb. of water evaporated under dry and saturated conditions, only .9 lb. of water need be required if the steam be superheated 100 deg. Assuming the feed temperature as 200 deg. the heat absorbed in the boiler for 1 lb. of steam at 150 lbs. gage without superheat is 1,027 b. t. u. The heat in .9 lb. of steam under the same conditions, is 9,243 lb. t. u., the difference, 1,027 b. t. u., being saved. To secure this saving in the amount of water evaporated, 100 deg. superheat must be applied to each pound of steam. According to the latest steam lb. of steam under the same conditions, is 9,243 b. t. u., the This amount of heat, added as superheat, saves twice as much heat, 102.7 b. t. u. in the boiler. It may therefore be said that by using superheated steam there is obtained a fuel economy equal to half of the steam saving. This means that heat imparted to a superheater is just twice as valuable and generates just twice as much power as heat imparted to a boiler.

The excellent papers that have been presented before this association on superheaters, the last two or three years are very commendable. The very useful work and important data bearing on this subject, which has been furnished by Prof. Endsley of Purdue University, is of great benefit to the railways of this and other countries, and the work done by locomotive engineers has been thorough and satisfactory. The splendid work of H. H. Vaughan of the Canadian Pacific, has also been of material benefit to our association, as well as paving the way for more extensive use of superheaters in connection with locomotive and stationary boilers. There have been very many interesting papers and subjects brought before this association in the past decade, and no subject is more interesting and of greater value than the question of superheated steam, in connection with high power central station work and locomotive practice.

W. F. M. Goss: I rise merely for the purpose of making a very brief observation. My impression is that this is the time for a new testing plant. This plant has been in operation now for 21 years, and I want to remind the members of the association that almost every year it has brought a contribution to the association during those 21 years; and I think that if an index were made of the subjects of reports contributed, it would be found to cover a pretty wide range of the association's interests; and in making this observation, I want to express the hope that means will be supplied to Prof. Endsley, whereby this testing plant will be continued.

C. D. Young (Penna.). Mr. Endsley, if I understand him correctly, has not developed the point so far on his tests that he did not form some observations which we have recently made where we are using a high degree of superheat. It was thought that if superheated steam was furnished to the cylinders of an engine, that certain economies would develop. We found that under certain conditions, the water rate on the cylinders would be poorer with a dry and saturated steam furnished under different conditions. That came up in this way: In operating a very large cylinder with superheated steam furnished at 160 or 150 lb. boiler pressure, with 260 degs. of superheat, it was necessary, in order to do the work, to use a cut-off of approximately 70 per cent. and a piston speed of about 350 f. p. m. In other words, this was slow speed, 10 mile service. Under these conditions the water rate was about 26 lb. to 27 lb. of steam per hour, showing quite clearly that where the piston speed is low and the cut-off long there is no economy in superheating; and if it is operated only under those conditions, it would not pay to put a superheater on the boiler. I believe that confirms what Prof. Endsley has found out so far. There is one point which Prof. Endsley brought up which is of interest. He stated that he had obtained the same amount of power from a superheated locomotive, with a reduction in boiler pressure of approximately 40 lb. I think that in modern practice it is necessary to obtain all the power you possibly can, and it is not advisable to reduce the boiler pressure in a great many cases for the simple reason that you have not clearance space enough to make the cylinders big enough to operate with the lower boiler pressure, and in order to operate it, it is necessary to keep the cylinder down to 27 in. or 28 in. in diameter, and therefore you must hold the boiler pressure up to 200 lb. in order to produce the power desired. That being the case, it seems to me that something should be done

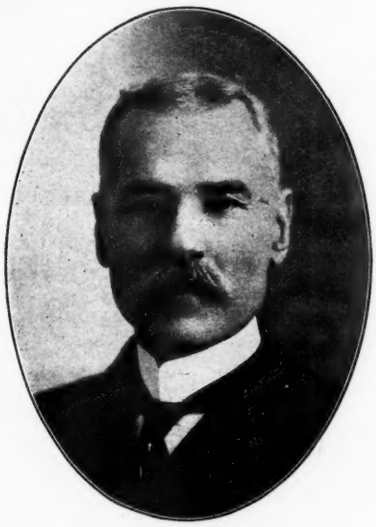
as to the boiler pressures which are required under the existing conditions of design. I think if it is possible it would be well for you to consider next year a thorough range in the investigation around the present modern boiler pressures which are absolutely necessary to the designer in order to get the cylinders through the clearance which is provided.

Prof. L. E. Endsley: I might say that I did not mean to state that we were not going to do any work at 200-lb. pressure; we are going to do work at 160 lbs. and 200 lbs., and even as low as 120 lbs. We are doing some work that low. Our boiler is equipped to run at 240 lbs. What I did mean to say was, that you can increase your cylinders 4 to 5 inches and reduce your cut-off, and not cause a slippery engine—because you know what will happen. What we are going to do is to carry the tests with the largest cylinder, at 160 lbs. and 200 lbs., and possibly 240 lbs., next year. So we will have the entire field covered.

C. A. Seley (C. R. I. & P.): I move that the thanks of the association, expressing our appreciation, be extended to the gentlemen who have given us this paper. The motion was carried.

STEEL TIRES.

Since the last convention, the committee, which was continued with a view to presenting a specification from which railway companies could purchase tires, with confidence that they would give the service expected, have worked to that end. Recognizing the importance of a drop test, the committee has gone to considerable trouble in getting the very best practice of the old and new worlds, but as will be seen, clause 8 leaves it optional with the railway companies to demand or not as they wish. The rules for the drop test have been drawn up



L. R. JOHNSON,
Chairman, Committee on Steel Tires.

with the idea of utilizing as far as possible the drop-test machines already in use for other purposes, and so sparing the manufacturers the expense of making special ones for tires.

SPECIFICATION FOR STEEL TIRES.

1. Material.—Stock for tires shall be made by the open-hearth or crucible process.

2. Classes.—There will be three classes of tires for the different classes of service as follows:

Class 1. Driving tires for passenger engines.
Class 2. Driving tires for freight engines.
Class 3. Driving tires for switching engines, and tires for engine truck, tender truck, trailers, and car wheels.

3. Chemical Composition.—

Class 1.	Carbon not less than	0.50 per cent. or over 0.70 per cent.
	Phosphorus, not over	0.05 per cent.
	Manganese between	0.50 per cent. and 0.80 per cent.
	Sulphur, not over	0.05 per cent.
Class 2.	Carbon, not less than	0.60 per cent. or over 0.80 per cent.
	Phosphorus, not over	0.05 per cent.
	Manganese between	0.50 per cent. and 0.80 per cent.
	Sulphur, not over	0.05 per cent.
Class 3.	Carbon, not less than	0.70 per cent. or over 0.85 per cent.
	Phosphorus, not over	0.05 per cent.
	Manganese between	0.50 per cent. and 0.80 per cent.
	Sulphur, not over	0.05 per cent.

4. Finish.—The tires must be free from defects of any kind, and finished tires must be accurately machined to the prescribed dimensions of the Master Mechanics' standard, and roungh tires must not be outside the limits of the attached prints.

5. Branding.—The tires shall be distinctly stamped when hot with such brands as the purchaser may require, and in such a manner that those marks shall be legible when the tires are worn out.

6. Samples for Chemical Analysis.—Drillings from a small test ingot cast with the heat, or turnings, from a tensile specimen, or turnings from a tire (where tires are machined at the works of the manufacturer) shall be used to determine whether the chemical composition of the heat is within the limits specified in paragraph 3. When required, the purchaser or his representative shall be furnished an analysis of each heat from which tires are made.

7. Physical Properties.—The steel for the different classes of service shall meet the following minimum physical requirements:

Class.	Tensile strength. Lbs. per sq. in.	Elongation per cent. in 4 in.
(a)	105,000	Quotient of 1,556,000 divided by the tensile strength.
(b)	115,000	Quotient of 1,300,000 divided by the tensile strength.
(c)	125,000	Quotient of 1,150,000 divided by the tensile strength.

8. Falling Weight Test.—Should the contract call for a falling weight test, a test tire from each heat represented shall be selected by the purchaser or his representative and furnished at his expense, provided it meets the requirements.

8a. The test tire shall be placed vertically under the drop in a running position on a spring foundation with an anvil of at least ten tons weight, and shall be subjected to successive blows from a tup weighing 2,000 lbs. falling from heights of 5 ft., 10 ft., 15 ft. and 30 ft. and upwards, until the required deflection is obtained as specified in paragraph 8b.

8b. The test tire shall stand the drop test described in paragraph 8a without breaking or cracking and shall show a minimum deflection equal to X in the following table:

	Class No. 1.	Class No. 2	Class No. 3.
3 ft. diameter and over	$\frac{3\,d}{6\,t}$	$\frac{3\,d}{10\,t}$	$\frac{3\,d}{12\,t}$
Under 3 ft. diameter	$\frac{3\,d}{10\,t}$	$\frac{3\,d}{12\,t}$	$\frac{3\,d}{14\,t}$

Internal diameter of tire = d. Thickness of tire = t.

8c. A specimen for the tensile test is to be taken from a tire that has been subjected to a falling weight test, and it shall be cut cold from the tested tire at the point least affected by the falling weight test. The tensile test specimen when cut from a tire that has been subjected to a falling weight test shall be cut normal to the radius and parallel to the face.

8d. Should the test tire fail to meet these requirements in any particular, two more test tires shall be selected from the same heat if the manufacturer so desires, and at his expense. Should these two tires fulfil the requirements, the heat shall be accepted.

9. Inspection.—The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times while his contract is being executed. All reasonable facilities shall be afforded to the inspector by the manufacturer to satisfy him that the tires are being furnished in accordance with the specifications. All tests and inspections shall be made at the place of manufacture prior to shipment, and shall be conducted so as not to interfere unnecessarily with the operations of the mill.

Tires must be rolled in accordance with the best practice, sufficient metal being discarded to insure sound tires. The tire taken from the bottom of the ingot must be stamped with the letter *A*, before the tire number, the next above *B*, and so on up the ingot.

Tensile test specimens, one from each heat, must be forwarded to the engineer of tests of the railway company, together with a copy of the chemical analysis of each heat, showing the tire numbers rolled from each heat; also destination of each tire, together with the railway company's purchasing agent's order number. If, however, the manufacturer is rolling tires right along for the railroad company, and their inspector is at their plant, the test specimens from heats ready at that time may be pulled at the manufacturer's plant by the inspector and the broken test pieces sent in for analysis, in which case the above information must be furnished the inspector.

An analysis of the test piece made by the railway company's test bureau must agree with that furnished by the manufacturer, and with an analysis made from turnings from the tires after received; a failure to agree within reasonable limits will be cause for rejection.

In addition to the above tests, the railway company reserves

the right to make a repetition of any tests to make sure that only material meeting all requirements set forth in this specification be accepted, and all material found not up to any one or all of these requirements will be rejected.

Samples representing rejected material will be retained in the test bureau not longer than thirty days from date of test. If at the end of that period the sellers have not signified their desire for a rehearing, it will be understood that they agree with the results as reported. If by this time the sellers have not given shipping directions for material rejected at destination, the material represented by the samples will be returned to them at their risk, they paying freight both ways.

The report is signed by:—L. R. Johnson (C. P.), chairman; R. L. Ettinger (So. Ry.); J. R. Onderdonk (B. & O.); C. H. Hogan (N. Y. C. & H. R.) and L. H. Turner (P. & L. E.).

The secretary: The report was received, and action on the recommendation was deferred another year.

LOW WATER BOILER TESTS.

The accompanying photographs show the general arrangement of the boilers and accessories for the low water boiler tests which will be made on June 20, 1912, at Coatesville, Pa. These tests will be the culmination of an extensive series of researches that have been under way for five months for the purpose of determining the relative efficiency, capacity, water circulation and strength of a Jacobs-Shupert and a normal radial stay boiler. All this work has been outlined by and conducted under the direction of Dr. W. F. M. Goss, Dean of the Schools of Engineering, University of Illinois.

Both boilers are identical in design and size, except that one has a Jacobs-Shupert firebox, while the other has a radial stay firebox of standard construction. The general dimensions of each boiler are as follows:

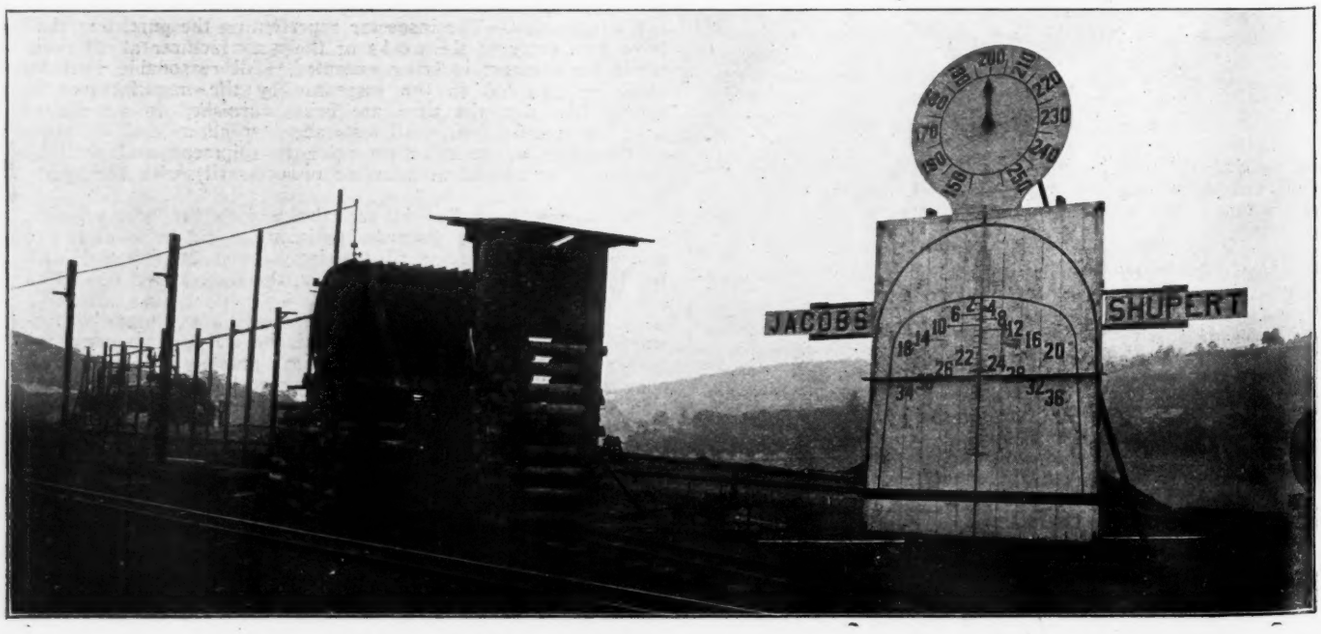
Outside diameter of shell of boiler at front end...	70 in.
Diameter of shell at throat.....	83⅞ in.
Number of 2¼-in. tubes.....	290
Length of tubes.....	218 in.
Inside length of firebox.....	109⅝ in.
Inside width of firebox.....	76⅛ in.

Each boiler has a total heating surface of about 3,000 sq. ft.

For the purposes of the low water tests, the two boilers have been placed on the cinder dump of the Lukens Iron & Steel Company, and a grandstand has been erected on a hill about 2,500 ft. from the nearest boiler, in order to afford a good view without danger if explosion takes place.

Both boilers will be fired with oil, and the feed water will be supplied from a large pump, operated by an auxiliary boiler not visible in the photographs. The boilers will be controlled by the observers from the inside of a firebox turned on its side and placed about 225 ft. distant from the nearest boiler. All valves controlling the oil fuel, water supply and steam discharge are located within this firebox barricade. The elevated tank just to the right of the barri-

General View of Apparatus Arranged for Low Water Tests at Coatesville.



Water Level and Steam Pressure Indicator at Coatesville Tests.

cade contains the oil fuel, which flows therefrom to the burners by gravity.

The test boilers are placed about 50 ft. apart. The firebox end of each rests on a concrete foundation, and the front end rests on light tumblers, so that when explosion takes place, the movement will be away from the observers.

In order that all witnesses can be kept constantly informed during the progress of the tests, a novel water level and steam pressure indicator has been erected. This consists of a large board, on which there is an outline of the cross-section of the firebox. A block bar, movable vertically, extends across this board and represents the water level. The observers in the barricade can control the position of this bar, which can be plainly seen from the grandstand. On top of this board is a large dial with a movable pointer, and by means of this the steam pressure and any variations thereof will be indicated.

The Jacobs-Shupert boiler will be the first one tested. The test will begin by bringing the boiler up to normal working pressure and water level. The excess steam generated by the boiler will blow off through the pop valves, the principal portion will pass through the exhaust pipe and up the stack in the usual manner to produce the necessary draft. When the rate at which it is working has become fairly high and representative of service conditions, the feed water supply will be shut off. The water level will therefore gradually drop and finally go below the crown sheet, thus causing overheating of the metal and ultimate failure. As soon as the Jacobs-Shupert boiler is tested, the radical stay will be similarly treated. A small fire will continue in the radical stay boiler during the test of the Jacobs-Shupert so that no time will be lost in getting the second test under way.

The tests will begin at 1 P. M. Guests from Atlantic City should reach Philadelphia, Broad Street Station, in time to catch the train leaving there at 11:45 A. M., which reaches Coatesville at 12:48 P. M. In order to catch this train it will be necessary to leave Atlantic City at 10 A. M. via. the Pennsylvania, Delaware River Bridge route. Guests can leave Coatesville going west at 5:46 P. M., reaching Harrisburg at 7:20 P. M., and going east can leave at 5:16 P. M., reaching Philadelphia at 6:23 P. M. Incoming trains will be met at Coatesville by representatives of the firebox company and conveyances will be provided to take the guests to the grandstand and demonstration field, where a buffet luncheon will be served.

INFORMAL DANCE ON THE PIER.

An informal dance was given on the Million Dollar Pier last night. It was largely attended, and the crowd seemed to have a very good time. The committee in special charge was composed of Thomas Farmer, Jr., chairman, E. S. Toothe, W. J. Walsh, H. E. Osterreich, Harry S. Hammond, William Miller, H. A. Nealley, E. F. Chaffee, Roger J. Faure.

SUPERHEATED STEAM ON MALLET LOCOMOTIVES.

The popularity of the Mallet locomotive, occasioned by the saving it is possible to obtain on account of the great amount of power developed by a single unit, was influenced to some extent at the start by the low efficiencies attending its operation. The condensation losses of the Mallet locomotive are abnormally high because of the large cooling surfaces in the steam passages from the boiler to the cylinders and in the cylinders themselves. To eliminate these losses, and to raise the standard of efficiency of operation of so large a unit to what it should be, the use of superheated steam has been resorted to in some cases.

Two distinct methods were adopted at the beginning. One introduced two superheaters; one between the boiler and the high pressure cylinders, and the other between the high and the low pressure cylinders. This method is accompanied by high installation and maintenance cost, and considerable difficulty in maintaining the superheater between the high and the low pressure cylinders on account of its inaccessibility.

The other method is that in which but one superheater is used, placed between the boiler and the high pressure cylinders, and giving the steam a high initial temperature before it enters the high pressure cylinder. This temperature should be sufficient to carry it to the low pressure exhaust without condensation losses. The superheater employed to accomplish this is

ENTERTAINMENT COMMITTEE.

Upper row, left to right: McClintock, Landreth, Nellis, Chaffee, Hammond, Kreps, Illingworth.
Bottom, left to right: Sherman, Wardell, Toothe, Dunkelberg, Walsh, Mitchell, Hibbard, Younglove, Nealley, Green, Furry.

of the fire tube type, which delivers steam at a temperature of from 600 to 650 degrees F., and is located in a manner which makes its installation and maintenance possible at the expense of a minimum amount of labor.

Conclusive and reliable tests have been made to determine the economies obtained by the use of highly superheated steam, and in every case they indicate a remarkable saving in coal and water, as well as the increase in drawbar pull. Through ranges of speed from twelve to eighteen miles an hour, averages show a saving of dry coal per dynamometer horsepower of about 28 per cent., and an increased drawbar pull of 12 per cent. This saving and the increase in tractive effort show clearly the part that the superheater has played in making the Mallet engine an economical unit.

Another advantage of the superheater applied to Mallet engines is the protection afforded against damage to the high pressure steam pipes, steam chests and cylinders, occasioned by foaming. This percentage of priming is greater in the Mallet type than in the older types, on account of the length of the boiler. With the use of the superheater it is practically impossible for water carried into the dry pipe to reach the cylinders in the form of water.

In the last analysis the operating limit of any locomotive is fixed by the ability of the fireman to properly supply fuel to the firebox. As a result of the application of an efficient superheater the capacity of the fireman, measured by the drawbar pull, is increased to an even greater percentage than the reduction in coal consumption.

REVENGE!

When the women go a shopping
And take us dubs along,
They try to make us think we're it,
And right where we belong.

They ask us our opinions
On lacy lingerie,
But how much we will pay is what
They really want to see.

But every doggie has his day—
And now *our* turn has come.
So get together, brothers,
And we'll surely have some fun.

Let one and all his wifey bring,
Out on the great big pier.
No matter where we stop and talk
You'll bore her; never fear.

Go talk to Bourne on his device;
On superheated steam.
Before he's through she'll tear her hair
And then let out a scream.

There's Weatherly, of valve gear fame,
Whose spiel on lap and lead
Will make her want to grab a train
To Reno to be freed.

At last a talk on cutting speeds,
Done on the Bullard tool,
Will prove to her, without a doubt,
You're not a *silly* fool.

So after all, that's all we want;
Don't care about the bills.
If only they will leave us home
When purchasing their frills.

DEATH OF MAJOR E. H. JANNEY.

E. H. Janney, inventor of the coupler which bears his name, and which was the origin of the present M. C. B. standard coupler, died at his old home, Alexandria, Va., June 16, aged 80 years. Major Janney was field quartermaster on the staff of Gen. Robert E. Lee during the Civil War. The Janney coupler was first applied to passenger cars on the Fort Wayne line under the direction of J. D. Laing. About 1878 the McConway & Torley Company assumed control of the patents and began making the Janney coupler. They developed it so that it was adopted for passenger cars by the Pennsylvania Railroad, and soon found application on freight cars, and the lines and principle were adopted as standard by the M. C. B. Association in 1887. After selling the patent, Mr. Janney retired from active mechanical work and purchased a farm near Alexandria, where he quietly spent his remaining years. Mr. Janney was a clerk in a grocery store at the time he invented the coupler and we are thus indebted to the mercantile business for this valuable invention. The idea was suggested by the clasping of two hands in a vertical position with the knuckles bent.

M. M. REGISTRATION.

Aldcorn, Thos., Chicago Pneumatic Tool Co., Marlborough-Blenheim.
Allen, G. S., Retired M. M., P. & R. Ry., Shelburne.
Antz, Oscar, G. C. L. E., N. Y. C. Lines, Pennhurst.
Boyden, J. A., M. M., Erie R. R,, Chalfonte.
Cross, W., Asst. to 2nd Vice-Pres., Can. Pac. Ry., Marborough-Blenheim.
Dalton, Wm., Chief Engr., Traymore.
Dickson, Geo., Insp. Dept., Baldwin Loco. Wks.
Eich, H. C., M. M., Ill. Central, Haddon Hall.
Elliott, J. B., M. M., Baltimore & Ohio R. R., Elberon.
Fitz Simmons, E. S., Mech. Supt., Erie R. R., Shelburne.
Fulmore, John H., M. M. Penna. R. R.
Gilmour, Geo., Supt. Inspt., Travelers Ins. Co., Rudolf.
Goss, W. F. M., Univesity of Illinois, Haddon Hall.
Henderson, Geo. R.
Herr, E. E., Engine House For., P. R. R.
Hill, James W., M. M., Peoria & Pekin Union, Lexington.
Lanza, Galtano.
Leach, W. B., Marlborough-Blenheim.
Lewis, W. H., S. M. P., Norfolk & Western R. R., Marlborough-Blenheim.
McCarthy, M. J., S. S., C. C. C. & St. L. R. R., Marborough-Blenheim.
Markey, Jas., M. M., Grand Trunk Ry., Haddon Hall.
Patterson, Robert, M. M., Grand Trunk Ry., Marlborough-Blenheim.
Smith, Carl B., M. E., Boston & Maine R. R., Brighton.
Turner, J. S., Sales Agent, Pressed Steel Car Co., Marborough-Blenheim.
Wilson, Charles, M. M., Lehigh Valley R. R., Elberon.
Woodbridge, H. C., Gen'l Mgr's Special Rep., B. R. & P., Arlington.

M. M. GUESTS.

Allen, T. B., Engine Dispatcher, Penna.
Arter, Wilbur D., Asst. Eng., N. Y. Central, Pennhurst.
Austin, Geo., G. B. I., A. T. & S. F., Marlborough-Blenheim.
Balfour, C. J., Gang Leader, Penna. R. R.
Beck, Henry J., Gen. Loco. Insp., Spydel.
Beck, I. H., Air Brake Foreman, C. R. R. of N. J., Speidel.
Bixby, O. M., Electrical Dept., N. Y. C. & H. R. R., Lexington.
Campbell, H. A. T.
Carey, J. T., M. P., P. R. R.
Carter, G. H., Gen. Foreman, P. & R., Norwood.
Cooper, W. H., Div. Storekeeper, P. & R.
Cotton, A. C., S. P. P., P. R. R., Shelburne.
Cox, Millard F., M. E., L. & N. R. R., Chalfonte.
Cramer, C. B., Gen. Foreman, Wash. Terminal Co.
Crossman, T. E., Official Reporter, St. Charles.
Co., Whittel.
Daly, John J., Boiler Maker For., P. & R. R. Y. Co., Ramsey.

Davidson, W. W., Gen. Foreman Trenton Shop, Penna. R. R.
Davis, P. L., M. P. Insp., P. R. R.
Dawson, W C., Foreman, Wash. Terminal Co.
DeSalis, J. H., Chief Rd. For. Engines, N. Y. C. & H. R.,
Dillon, Howard W., Draughtsman, P. R. R.
Pennhurst.
Diven, J B., Asst. Engr. M. P., Pennsylvania.
Dix, Chas. S., Boiler Maker, P. R. R., Atlantic City.
Eggleston, Harry D., Rd. For. Engs., P. & R.
English, J. P., Night For., Central R. R. of N. J.
Finney, H. R., Asst. Rd. For. of Engines, P. R. R., Chalfonte.
Frost, H., Enginehouse Foreman, Penn. R. R.
Gallagher, F. S., Asst. Mech. Eng., N. Y. C. & H. R. R. R.,
Gallagher, P. F., Shop Foreman, B. & O., Lexington.
Marlborough-Blenheim.
Galloway, W. S., Asst. P. A., B. & O. R. R., Marlborough-Blenheim.
Gerhardt, E. A., Clerk, D. L. & W., Lexington.
Gormley, J., Asst. Trainmaster, P. R. R., Jackson.
Goslive, E. W., Foreman Pipe Dept., P. R. R.
Gough, P. J., Storekeeper, P. & R., Norwood.
Graham, J. P., Foreman Elec. Dept., P. R. R, Dunlop.
Green, G. H., Chief Insp., Rock Island, Shelburne.
Groosoors, Edw. W., Foreman, P. R. R.
Guinand, Harry W., Clerk Pur. Dept., Penna.
Haines, W. S., M. M., Erie R. R., Schlitz.
Hall, G. A., Frt. Conductor Meritorious Service, Penna. R. R.
Herbert, Wm. A., Foreman Terminal, P. R. R.
Hinis, J. P., Gen. Foreman Loco. Shops, B. & O., Monticello.
Hinkle, H. M., Asst. Rd. Foreman of Engines, Penna., Ellwood.
Hofmann, G. W., Asst Rd. Foreman, Northern Central R. R.
Hosack, W. K., Mach. Foreman, B. & O., Monticello.
Howes, A. F., Loco. Engr., C. & N. W.
Hunt, J. F., Shop Clerk, West Jersey & Sea Shore.
Hurley, W. J., Supt. Mech. Instruction, N. Y. Central H. R.
R. R., Marlborough-Blenheim.
Jay, Thos. C., Ck. Office of Mech. Engr., D. L. & W. R. R.,
Dennis.
Justice, H. B., Asst. S. K., P. R. R.
Kelly, R. J., Gen. For. Car Shops, Long Island, Traymore.
Kreider. Charles N., Gen. Boiler Insp., P. & R., Monticello.
Ligon, L. P., M. M., N. & W.
Linthicum, Frank, A. R. F. E., West Jersey & Seashore R. R.
Longacre, C. J., G. H., P. R. R.
Lovett, Alfred E., F. P. T. D., Penna. R. R. Co., Arlington.
Lukens, Howard A., Clerk to P. M. Agent, Penna.
Mahoney, M. A., Claim Agt., N. Y. C., Galen Hall.
Mallam, T. L., Foreman, P. R. R.
Mansfield, J. J., Ch. Boiler Insp., C. R. R. of N. J., Arlington.
McMenamin, Chas. G., M. P. S., Pennsylvania, Chalfonte.
McSweeney, J. T., Shop Foreman, B. & O., Lexington.
Meehan, J. E., Painter, P. R. R.
Miller, T. E., Rd. F. of Eng., B. & O. R. R., Lexington.
Monath, J. W., Gang Leader, P. R. R., Iroquois.
Montgomery, Wm. H., Trav. Freight Solicitor, P. R. R.
Murray, J. B., Ass't F., P. R. R.
Murray, L. B., Engineer, The Virginian R. R., Strand.
Nation, J. D., Traveling Eng. Penna.
Neale, F. A., Gen. For. C. R. R. of N. J., Pennhurst.
Nelson, W. J., Jr., Ck. P. D., Penna.
Nicholas, R. H., Genl. Foreman, Central R. R. of N. J.
Oswald, Wm. E., Shop Foreman, C. R. R. of N. J., Edison.
Ott, Wm. B., M. M., P. R. R., Whittle.
Reynolds, J. H., Clk. Office Shop, P. R. R.
Russell, Harry B., Engine House For., P. & R.
Roberts, G. H., Machine Foreman, Long Island, Pennhurst.
Roberts, W. N., Foreman, P. R. R.
Roche, J. J., Blacksmith Foreman, C. R. R. of N. J., Islesworth.
Rommel, G., M. M., B. & O.
Sanford, H. F., A. B. I. of N. J. Div., P. R. R. Co.
Sanford, J. W., Retired M. M., W. J. & S. R. R. Co.
Scott, Harry C., Foreman Machinist, C. R. R. of N. J., Fredonia.
Scott, H. E., Foreman Tin Shop, P. R. R.
Seiders, Irwin A., Rd. For. of Engines, P. & R., Monticello.
Sensenbach, C. A., Foreman Blacksmith, Pa. R. R., Ardmore.
Struter, L. P., Air Brake Engr., Illinois Central R. R., Haddon Hall.
Thompson, G. M., Machinist, Penna.
Toomey, T. H., F. E. Shops, P. R. R.
Watson, David, Genl. Foreman, B. & O., Baltimore House.
Westley, Isaiah S., For. Engine Shop, P. & R.
Williams, David T., Mech. Eng., P. & R.
Wilson, G. E., S. L. O., B. & O. R. R., Young's.
Wilson J. M., Eng. House For., P. & R., Elberon.
Winkler, L., Machinist, Penna.
Woollven, F., Mech. Dept., Baldwin Wks., Ostend.
Woolven, J. C., Mech. Dept., Grand Trunk, Ostend.
Yost, Wm. M. K., Ch. Dept, P. & R., Shelburne.

Conventionalities.

Komical Jack Turner, the Pressed Steel Car man, arrived on late schedule Sunday with a brand new stock of "sayings."

H. W. Jacobs, assistant superintendent of motive power of the Santa Fe, is here to attend the Master Mechanics' convention.

Mrs. R. D. Smith is confined to her room at the Dennis with a badly sprained ankle received while visiting the exhibits on the pier.

Emmett K. Conneely, purchasing agent of the Pittsburgh & Lake Erie, is stopping at the Brighton. Mrs. Conneely is with him this year.

H. Wright, an examiner of patents for the United States government at Washington, is attending the convention and is stopping at the Marlborough-Blenheim.

R. M. Dixon, president of the Safety Car Heating & Lighting Company, arrived Monday night and is registered at

C. L. Bundy, General Car Foreman of the Delaware, Lackawanna & Western.

the Dennis. Mr. Dixon returned at the end of May from a five weeks' trip to Europe.

Chairman Philip J. Mitchell, of the entertainment committee, was presented with an appropriate gift by the members of his committee Tuesday afternoon.

Mrs. M. K. Barnum had expected to attend the convention this year, but remained home to attend instead the high school graduation exercises of the youngest son.

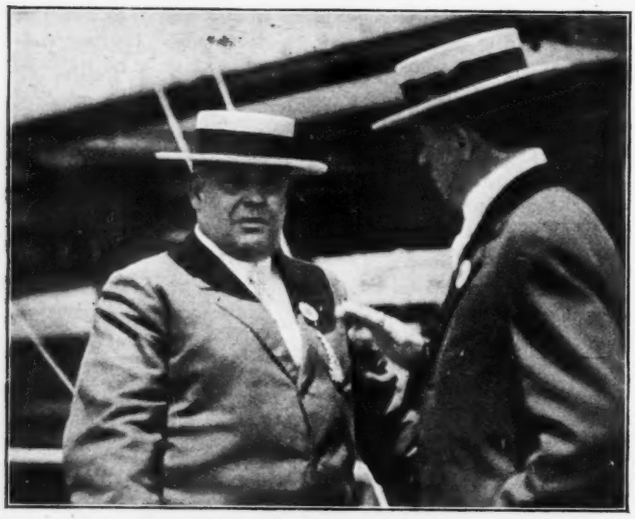
George A. Bardon, of the Chicago Pneumatic Tool Company, is attending the M. M. convention. He is stopping at Young's, and is accompanied by Mrs. Bardon.

R. B. Keller, superintendent of apprentices on the Delaware, Lackawanna & Western, is stopping at Haddon Hall. The apprentice instruction on the Lackawanna is being extended and is giving good results.

Walter H. Cottingham, president of the Sherwin-Williams Company, accompanied by his family, will sail on the "Celtic" on June 20 for England. They will occupy their country estate near London during the summer.

E. S. Wortham, purchasing agent and assistant to the vice-president of the Chicago & Alton, through a stenographic error, was transferred to the C. & O. in Monday's registration. We are pleased to put him back on the C. & A.

Tuesday must surely have been "tag day" on the pier, for George Molleson was observed wearing two supplymen's



W. H. Dooley, Superintendent of Motive Power of the Queen & Crescent.

badges. Inasmuch as he had registered as representing two companies, the guards at the door allowed him to enter as often as he pleased.

One thing that has been even more missed this year than J. Will Johnson's band of last year has been Secretary Joe Taylor's white suit. The soft pedal that has been applied to so many things this year seems to have affected the esteemed secretary's sartorial tastes.

W. N. Mitchell, of the International Correspondence School, is the happy possessor of two Republican National Convention tickets. While in Atlantic City for the conventions he received two telegraphic offers for his tickets, but declined both. He left Monday for Chicago.

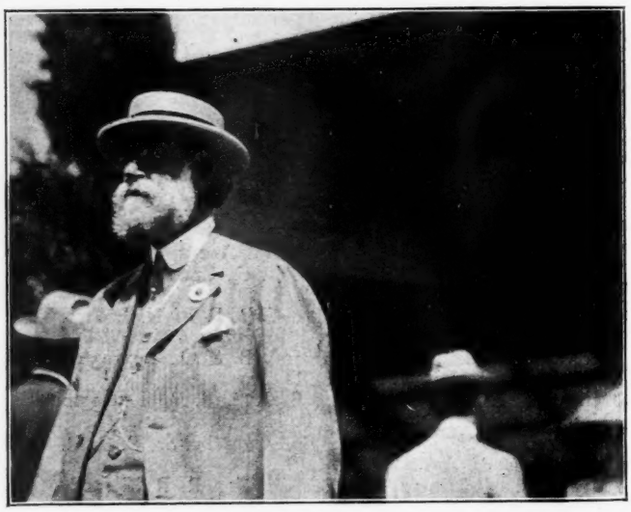
I. N. Kalbaugh, S. M. P., Coal & Coke Company, and F. B. Ernst.

S. L. Bean, mechanical superintendent of the Santa Fe, is the second railroader from Los Angeles, Cal., to attend the conventions this year, D. P. Kellogg, shop superintendent of the Southern Pacific, also being here. Mr. Bean makes a most favorable report of conditions on the Santa Fe and on the Pacific coast.

H. A. F. Campbell, designer at the Baldwin Locomotive Works, is numbered among the special guests. He has recently developed some very interesting information in connection with the counterbalancing of locomotives, which has had a very noticeable effect on the steadiness of some of the recent high speed power.

George W. Kelley, blacksmith foreman of the Central Railroad of New Jersey and a prominent member of the International Railroad Master Blacksmiths' Association, spent a day at Atlantic City looking over the exhibits. He predicts a record breaking meeting of the Master Blacksmiths' Association in Chicago next August.

Not according to the editor, but through a liberty taken by the compositor, it was stated in this column yesterday that Mrs. Flint "was formerly for several years with Manning, Maxwell & Moore." While it is clear that the "s" was



W. C. Arp, Superintendent of Motive Power of the Vandalia.

inserted in error, we hasten to explain that it was Mr. Flint, not Mrs. Flint, who was with the concern named.

J. J. McCarthy, president of the Chicago-Cleveland Car Roofing Company and ex-president of the Hod Carriers' Union, an organization of prominence in the "good old Saratoga days," is not here because of illness in his family. This is the first time in many years that Mr. McCarthy has not put in an appearance at these annual gatherings.

L. R. Pomeroy, who has been an associate member of the Master Mechanics' Association since 1889, is continuing his custom of not missing a convention. He arrived on Monday morning, and will attend the low water boiler tests at Coatesville at the close of the meetings. Mr. Pomeroy is now in consulting practice in New York.

Farmer L. H. Turner sent word by his assistant, Dave Redding, that he could not find time to attend the conventions this year. It is believed, however, that this is only modesty on his part; the fact that his road has been selected by a noted efficiency engineer as a model of scientific management seems to have embarrassed him and scared him away.

W. C. Hayes, president of the Traveling Engineers' Association and superintendent of locomotive operation on the Erie, is attending the convention. Mrs. Hayes is with him and they are stopping at the Chelsea. Other officers of the Traveling Engineers' Association who are, or have been, in attendance at the convention this year are, W. O. Thompson, secretary; C. B. Conger, treasurer, and F. C. Thayer and V. C. Randolph, of the executive committee.

V. C. Randolph and L. R. Laizure, master mechanics of the Erie, are stopping at the Pennhurst. Mr. Randolph read a report on "Practical Instruction in Fuel Economy" at the Traveling Engineers' Association which attracted great attention, in fact, marked the high point of the convention. He was also elected on the executive committee of that association. The Erie method is to have supervisors of locomotive operation on each division to see that the enginemen are given practical instructions on fuel economy.

W. C. A. Henry, superintendent of motive power, Southwest system, Pennsylvania Lines West of Pittsburg, is attending the meetings of the Master Mechanics' Association. He is much interested in the subject of stokers and states

E. F. Cook, Assistant Vice-President of the Union Tank Line, Chatting with Friends.

that the underfeed type has almost ceased to be a matter of special interest on his system. There are now so many in successful use that the engine crews are not looking on them as a novelty or experiment. He is building a stoker instruction car, to be used in much the same way as an air brake instruction car is now used.

W. S. Moseley, chief draftsman of the Carolina, Clinchfield & Ohio, is among the special guests at the convention. The Mallets which have been in service on that road for some time are giving splendid results. Tests were made shortly after these were introduced and while the enginemen were not accustomed to handling them. In spite of this, they showed much greater efficiency than the consolidations. It is proposed to make another series of tests in the near future. The road is specially favorable for making tests of this nature because of the long uniform grade over which the trains are operated.

Eleven representatives of the Illinois Central have attended, or are in attendance at, the conventions this year. They include C. F. Parker, vice-president; M. K. Barnum, general superintendent of motive power; R. W. Bell, superintendent of machinery; J. M. Borrowdale, superintendent of the car department; Willard Doud, shop engineer; E. W. Jansen, electrical engineer; L. P. Streeter, air brake engineer; J. S. Sheafe, engineer of tests; C. A. Shaffer, general

J. W. Storey, Chief Draftsman, Central of Georgia.

inspector of shop tools; H. C. Eich, master mechanic; and Gus Reifsteck, secretary to Mr. Barnum.

As everybody knows, the initials of chairman Mitchell of the entertainment committee are "P. J." Through somebody's mistake, they were given on his official badge as "P. R." "Pennsylvania Railroad Mitchell," said a man who was looking at the badge yesterday. "They'll read it 'Pretty Rotten Mitchell' before we get through down here, I'm afraid," replied the chairman, referring to the expurgated entertainment programme. However, nobody but Mr. Mitchell is worrying about his administration of the entertainment features. Special conditions require special resources, and he has admirably adapted himself to the situation as it is.

Maham H. Haig, Mechanical Engineer of the Sante Fe.

The Exhibit.

The Gold Car Heating & Lighting Company, New York, has been demonstrating, at its booth, the new Ideal pressure reducing valve for car heating. It is claimed for the regulator that when once set it will not vary.

The new combination body and truck bolster car which has been shown among the track exhibits by the Mid-Western Car Supply Company, Chicago, will be routed to Chicago via the Reading and Lackawanna roads, leaving Atlantic City Thursday. The car will be tested at Chicago.

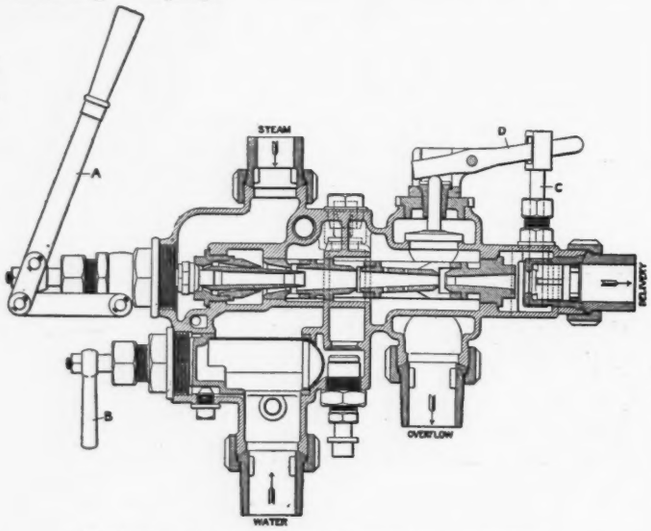
The Acme Supply Company, Chicago, at spaces 572 and 573, is making the first exhibit of Chanarch car floor plates. These plates are used with any of the composition floorings usually found in up-to-date passenger equipment. Chanarch automatically anchors the composition and weighs less and requires less composition than other floor plates, thus effecting a saving not only in cost, but operating efficiency. The Acme company will enlarge its plant on West Lake street and largely increase its output.

INJECTOR WITH AUTOMATIC OVERFLOW VALVE.

Since the invention of the injector by M. Giffard there has been a constant endeavor to improve its design and construction in accordance with the tendency toward increased boiler capacities and higher steam pressures. The first non-lifting injector manufactured by the Nathan Manufacturing Company, New York, consisting merely of a body and a set of nozzles, was followed by lifting injectors of the fixed nozzle type, the restarting type and of the non-lifting type, in which all operating parts necessary to start, regulate and stop it were contained in the injector itself.

All these types have their advantages, but also have weaknesses, one of which is the tendency to spill water at the overflow when the temperature of the feed water becomes higher than is suitable to the characteristics of the injector. This tendency has been overcome, in most cases, by what are called closed overflow injectors, in which the overflow is closed by hand-operated devices. This arrangement is unsatisfactory, and under certain circumstances may even be dangerous, because, if the jet is broken, the steam is blown back in the water tank, and, if it is not noticed, the water in the tank will soon become too hot to be handled.

All difficulties and uncertainties of this kind have been overcome in the D. and M. type injector, illustrated herewith, which represents an entirely new departure in injector construction shortly to be introduced by the Nathan Manufacturing Company.



Nathan D. & M. Type Locomotive Injector.

This new type is, in general, simliar to the restarting type of Simplex instrument, but includes an automatic closing and opening overflow valve. Letter *A* designates the ordinary starting lever, operating in the usual way, and *B* indicates the water valve by which the admission of water is regulated according to requirements. The injector is provided with the usual overflow valves and an auxiliary inlet valve. In the delivery chamber, moving in a suitably packed stuffing box, a small piston, *C*, which actuates a fulcrumed lever, *D*, that at the proper time acts on the overflow valve.

When the injector is started, the pressure in the delivery chamber slightly raises the piston, *C*, and the lever *D* bears down on the overflow valve and keeps it closed. Should the injector break from some cause, such as shortage of water, the pressure under the piston ceases and the overflow valve will open automatically. The injector then restarts automatically as soon as the water supply is restored. Closing the overflow is automatically repeated after the injector is again started.

This injector thus combines within itself the advantages of both the closed overflow and the open overflow injector, and entirely eliminates the disadvantages of the forcibly closed overflow. In view of the overflow being closed automatically, the injector is enabled to work feed water as hot as any type of injector with a hand operated overflow valve.

CUTTING COMPOUND.

An oil that is a distinct departure from the ordinary cutting compounds, is being introduced by Flint & Chester, Inc., New York. Contrary to the general characteristics of oil it thoroughly mixes with water and forms a solution that has all the advantages of water and at the same time the lubricating qualities of oil. It is known that a globule of water will resist a greater pressure than an oil globule, the difficulty in employing water as a lubricant being its lack of viscosity, or ability of globules to cling together.

As a mixture of from 10 to 20 parts of water to one of oil, depending on the character of work, forms the cutting compound, the cost of the mixture per gallon is small and it has the added advantage of cheap handling and storage, for the freight charges on and space occupied by one barrel of the oil cover a final mixture from 11 to 21 barrels. This oil is also valuable for hydraulic machinery. By using from 50 to 75 parts of water with one of oil it forms a preservative for the machinery as well as a lubricant.

The mixture does not give off the usual disagreeable odor when heated; it prevents rust, permits of heavier cuts being taken, and has healing instead of the poisonous qualities.

THE WESTINGHOUSE EXHIBIT.

Contrary to the practice of previous years, the several Westinghouse companies have had no working exhibit, their booth in the entrance hall being tastefully furnished as a place where members and guests of the convention could meet and talk. However, Westinghouse motors with control are being used in connection with the machinery exhibits of the following concerns: American Tool Works, 3 h.p. "CCL" motor driving a 2 ft. geared radial drill; a 20 h.p. "CCL" motor driving a 6 ft. radial drill. Baker Brothers, an "SK" adjustable speed DC motor on a 1 in. x 6 in. automatic drilling machine. Bethlehem Steel Company, two "CCL" motors operating a stress testing machine and a staybolt vibrating machine. Bullard Machine Tool Company, a 20 h.p. "CCL" motor on a 42 in. vertical turret lathe. H. H. Hewitt, two type "R" direct current motors on truck. Manning, Maxwell & Moore, Inc., an "SK" motor with drum type controller mounted on a Reed lathe, and an "SK" motor driving a National multiple spindle topping machine. Special attention is called to the automatic starter with this motor. Clement Street, two Westinghouse air brake motor-driven air compressors. Vixen Tool Company, a "CCL" motor driv-

ing a file testing machine. Yale & Towne Mfg. Company, two direct current motors operating hoists.

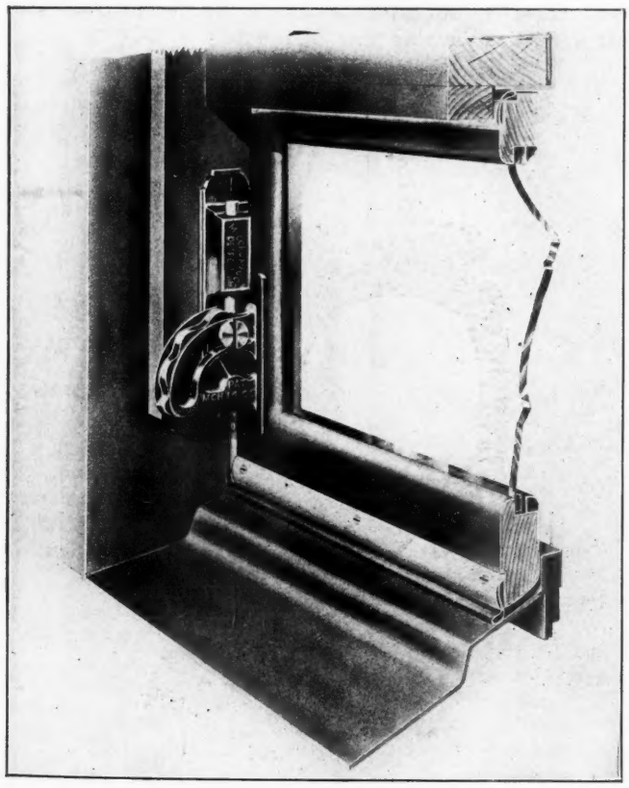
The booth is well lighted by 15 Westinghouse "Wire Type" lamps.

A NEW ELECTRIC DRILL.

There is an attractiveness to doing things by electricity that appeals to the imagination and the practical instincts of most people; hence the innate attractiveness of the electric drill shown by the Independent Pneumatic Tool Company, Chicago. It is not a very heavy affair, but it is good for holes in steel up to about 9/16 in. diam. There is a light shell carrying the fields, and revolving inside is a small armature. The shaft carries a pinion that meshes with a couple of gears which are pivoted on an arm attached to a sleeve serving as the drill spindle. The gears also mesh with an inside gear on the shell, so that as the pinion causes the gear to revolve they walk around and carry the drill spindle with them—a very simple and very old gear arrangement put to new uses that cuts the rate of rotation of the drill spindle relatively to armature shaft down in the ratio of one to nine. It is so simple that it seems strange no one has done it before. Then, with roller bearings and good workmanship, there are all the elments of ease of manipulation and satisfactory execution of work.

UNIVERSAL DECK SASH RATCHET.

Some things do seem too simple to exist. Take the old corrugated deck sash ratchet, for example, that was once used almost universally. The trouble was, that when it wore on its pivot it would slant and drop out of place. The McCord Mf'g. Company, Chicago, took it and put a



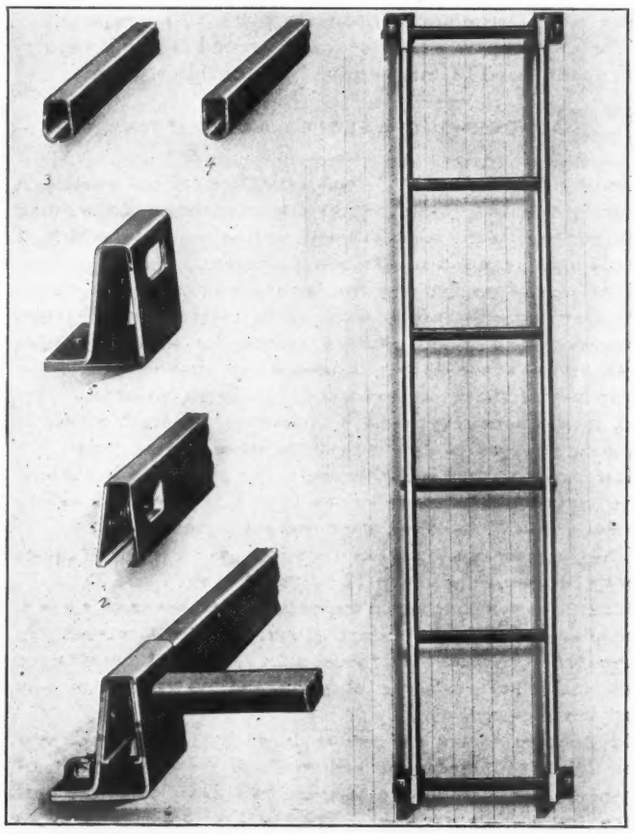
Universal Deck Sash Ratchet.

ridge along the inside, a sort of guard rail, as it were, for the spring stem, and a big-headed pivot pin to keep the thing in line—and there you are. The pin can't run off the track, because of the ridge and the ratchet can't wabble and get out of line; and so there are no more deck sashes coming down on the car floor, and no more sticky ventilators; while an abundance of fresh air is easily obtainable.

STEEL BOX CAR LADDER.

A box car ladder made of pressed steel is shown in the illustration. It consists of two continuous stiles, and required number of treads, and four straps fitted over the stiles for attaching to the car. This ladder, manufactured by the Acme Supply Company, Chicago, Ill., fulfills the specifications of the Interstate Commerce Commission. It is light in weight and ample in strength, and is attached to the car by only four bolts.

The stiles are made of inverted "U" shapes, with legs



Steel Box Car Ladder.

formed over ¼ in. along the edges. This allows complete access of air to all parts, preventing corrosion, and the shape provides ample strength. The length is made to suit conditions. The hole for the insertion of the tread is provided with a continuous ledge of ⅜ in.; thus providing a solid bearing for each tread in the stile. The depth is 2½ in., its width at the top ¾ in., and at the base 1¼ in. It is made of steel 1/16 in. thick.

The treads are formed so that there is a space left open, which is closed when the tread is fitted into its position in the stile, providing a spring fit of the tread which securely holds it in position. The shape of the tread not only furnishes a very good grip for hands and feet, but also makes an unusually strong construction. The depth of the tread is 1¼ in., and it is ¾ in. wide, and made of steel 1/16 in. thick.

The straps are attached to the stiles by means of rivets, and are further held in place by the tread, which engages the stile and strap at the same time. The strap holds the stile out from the car, and thus allows free access of air all around the ladder, and also permits of easy inspection. The strap is bolted through the sheathing of the car by

means of a ½-in. bolt, and has a total depth of 3¾ in., and a total base of 2 15/16 in. It is 3 in. long and is made of steel ⅛ in. thick. The toe of the strap can be turned either outward or inward as desired.

In a five-round ladder a tie-rod is placed from one stile to another through the tread at the middle. On a six-round ladder it is placed at the third tread from the bottom, as shown in 1. To make repairs it is only necessary to take out the tie-rod and two strap bolts and one stile can be completely removed. This ¼ in. bolt also serves as a tie-rod when the ladder is completely assembled and applied to the car.

The parts are made standard, so that repairs can be very easily made; they can be furnished upon receipt of dimensions as to length, etc. Any part can be placed in position in the ladder by simply removing the tie-bolt and two of the strap bolts, which permits the removal of one stile completely.

The approximate weight of the five-round ladder is twenty-five pounds, and of the six-round ladder thirty pounds.

AUTOGENOUS WELDING AND CUTTING.

During one week $216.36 was saved on various repairs in a western railway shop by the use of autogenous welding and cutting, with an additional saving of time which it would have required to get new parts, etc.

The cost of oxygen and the facility of getting it is naturally a great factor in this work. The International Oxygen Company, New York, offers a system for making oxygen right at one's works that is unique for simplicity, and the cheapness of the gases produced. Hitherto, to obtain oxygen, it was necessary to have a chlorate of potash plant, or to bring the gas in cylinders from some distant point. In either case the cost is rather high. At present it is claimed that oxygen can be made by the I. O. C. system at a saving of more than 75 per cent. over the old methods.

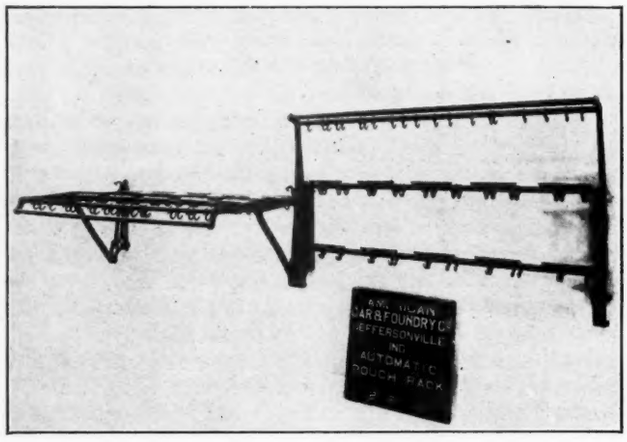
The International Oxogen Company has a 4-cell plant at Booth 307, which produces 12 cu. ft. of oxygen and 24 cu. ft. of hydrogen per hour, at an expenditure for power of 4 k.w.h. The plant requires no expert attention. Once started, the generators can run continuously for days and months, or even years; no replacing of parts and no repairs of any kind are required.

In addition to the oxygen produced by the I. O. C. system, 2 cu. ft. of hydrogen are produced for every cu. ft. of oxygen. The combination of these two gases gives the best flame for cutting purposes. Steel and wrought iron up to 24 in. in thickness can be cut by the oxy-hydrogen flame, which for cutting operations has proved superior to the oxy-acetylene flame. Oxy-hydrogen is used to great advantage in welding thin sheet steel, copper, brass, aluminum and all alloy metals; the oxy-hydrogen weld is said to be stronger and more elastic. Another important method of welding is the oxy-hydrogen-acetylene combination. These three gases together give an ideal flame, neither carbonizing nor oxidizing, and for this reason is suitable for a great variety of welding operations.

The I. O. C. system has been in use abroad for over ten years. The economy realized by this method in the cost of oxygen and hydrogen is large enough to pay for an installation in less than two years.

AUTOMATIC POUCH RACK.

The government is getting mighty particular these days, and especially as to the fittings of its postal cars. Pouch racks must be just the right size and shape; and weight that is excessive must be avoided. So the American Car & Foundry Company, St. Louis, Mo., has brought out a pouch rack that is light, has only ¼ in. between frames, and can be folded against the wall with all pouches hanging in place. It locks automatically open or shut, up or down,



Automatic Pouch Rack.

and has ample strength to carry its load. These racks may be seen at the booth of the company.

THE BUFFALO ADJUSTABLE BRAKEHEAD.

Whatever is wasted in brakeshoe scrap is real waste; and a pound or two is a pretty big percentage of total scrap. Now, don't do it. Just take the old Christie key that you have used for a generation to hold the shoe to the head and make it in the form of a spring. Then you have a slot in the back of the head. Drive the spring key down through it so that it bears on the beam. This will form a friction bearing that will hold the head in place,

The Buffalo Brakehead.

but will still allow it to turn under pressure. Then fit your shoe and apply the air, and the head will turn until the shoe has such an even bearing on the wheel that a uniform wear is insured. And the head will hold that place until the shoe is worn out. No, it isn't a kink that we originated; but the new adjustable brakehead that is being exhibited by the Buffalo Brakebeam Company, New York, and shown herewith.

Railway Age Gazette

DAILY EDITION

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THE EXHIBIT 1529

WHILE satisfied and loyal shopmen are a tangible value to a railway, contented and earnest foremen are of even greater importance. In fact, in most cases, it is not possible to have the former without first having the latter. It is noticeable in visiting the different shops throughout the country, that a spirit of enthusiastic loyalty for their roads and both their superiors and inferiors exists among the foremen at some places and is distinctly absent at others. It will well pay the head of a department to occasionally consider broadly the fundamental conditions and see that no opportunity is present for discord to start, or, if it is already evident, to find where the fault lies. The fundamentals are not confusing or involved and can usually be summed up in the term "square deal" or justice. Are your foremen getting all that it is their right to expect? Are they receiving a compensation in keeping with their responsibilities and their relative position, or are there workmen under their direction who draw larger checks on pay day? Does each know definitely within what limits he is supreme and just the limit of the authority of those around him? Is each actually supreme in his dealings with those supposedly under his direction? Is the line of promotion clear cut and straight forward? Is courtesy present in the intercommunications of the department? If these questions can be answered in the affirmative, it makes no difference how much work you demand of them, they will be satisfied and loyal. If these conditions do not exist it is pretty certain that discord and disloyalty are present even if not yet evident.

WHAT can be done in saving fuel by very simple means is well illustrated by the experience of the Baltimore & Ohio during the past year. Five supervisors of locomotive operation were appointed with instructions to study conditions on the sections of the road to which they were assigned and to recommend to the division officers, operating as well as mechanical, changes in methods or practices that would save coal. The work of these five men was very largely responsible for a saving of 12 per cent. in the fuel bill in the first year the scheme was in operation.

IN visiting the machine tool exhibit and noting the record performances being demonstrated, it is wise to make a mental computation to determine the possible output per day or week and compare it with the amount of work you have to do in the same time. Not infrequently it may be found that one of these machines will easily do the work that now requires two tools and its purchase can be easily justified. Again it may be discovered that the capacity of the machine is so great that its services would be required less than half the time under your conditions and the recommendation of its purchase will seriously reflect on your judgment in the choosing of future tools.

THE discussion on the maintenance of Superheater Locomotives was as extended and interesting as that on Boiler Design, as it was made to include questions relating to the general advantage of superheaters, and even invaded the realms of poetry and inspired the chairman of the committee to quote from Emerson that familiar passage about "troubles that never arise." While the subject of the report is so general as to cover the maintenance of locomotives equipped with superheaters, the instructions to the committee limit the range of the investigation to the quality of metal for the cylinder and valve wearing surfaces, and especially to lubrication, while the extra cost of maintenance, due to the superheater fixtures themselves, was not considered. It is, perhaps, too soon to obtain correct figures as to the cost of maintenance of any of these details, as the average time the superheaters have been in use on most lines is one year or less. During this period the question of proper lubrication of valves and cylinders using steam at high temperature has been developing, and the most satisfactory results have been only recently obtained. It is very fortunate for the success of the superheater that the problem of lubrication has been solved so successfully and placed beyond further question. It is fortunate also that a satisfactory metal for cylinders, valves and packing and forms of construction have been found which will permit the locomotive to do its work regularly under conditions of high temperature. This much having been achieved, superheating as applied to the locomotive must be regarded as a very valuable improvement, and it now

remains to ascertain the cost of the maintenance of the superheater itself, covering a period when renewals are required. While this expense may be small compared with the economies obtained, yet it will in time form a real additional charge to locomotive repairs and maintenance which must be reckoned with.

LOSS OF POWER IN LOCOMOTIVE EXHAUST.

THE loss of power due to back pressure in the exhaust of locomotives has been given so little attention that it is doubtful if mechanical officers could state within a large per cent. what it amounts to for a given type of engine working under normal load for any speed, or the relation of this loss to the total useful power developed at the drawbar. The various efforts to increase the capacity of locomotives usually relate to something positive in the way of additional apparatus, or increased dimensions, but little effort is directed to the reduction of negative influences which, if accomplished, would be equivalent to a positive gain in power without an increase in the dimensions of the locomotive or an addition to its equipment. Any increase in the size of the exhaust nozzle which reduces back pressure has this effect, and any substitute for the exhaust as a means for producing drafts, if more efficient will be a positive gain. It is the general impression that the power lost in back pressure in a locomotive of average size may amount to 150 to 200 h.p., but we are hardly prepared to find that on some Pacific locomotives this loss is equal to 590 h.p. and on Mallet engines it exceeds 1,000 h.p. These losses are almost equal to the total useful power obtained from the average passenger and freight locomotive.

In the elaborate paper on Locomotive Drafting and Its Relation to Fuel Consumption by H. B. MacFarland, engineer of tests of the Santa Fe, presented at the recent meeting of the Railway Fuel Association, the loss in power due to exhaust back pressure is given for the principal types of locomotives now used on the Santa Fe. The figures for back pressure and power lost were obtained from actual tests and seem to be unusually high, especially those for oil-burning locomotives. The test of the balanced compound Pacific type engine, showing the excessive back pressure already quoted, was in regular passenger service and burning oil. The loss in horsepower due to cylinder back pressure was 440 h.p. at 40 miles per hour and 590 h.p. at 50 miles per hour. On a somewhat larger simple Pacific type engine burning coal the back pressure horsepower at 40 miles per hour was 270, and at 50 miles per hour, 340. The greater loss with the compound engine is due to the greater area of the low pressure piston on which the back pressure acts, and this power loss should be in the ratio of the piston areas, other conditions being equal.

This limitation of the power of large locomotives by excessive back pressure on the cylinders is a subject which should be thoroughly investigated, as it is a large factor in their economical operation. It is not possible to operate non-condensing engines without at least 4 lbs. back pressure, but the loss due to excessive pressures beyond that is due to the inefficiency of the exhaust nozzle and smoke-box appliances for producing draft.

The actual power required to draw the gases through the tubes of a large locomotive is only about 20 h.p., and the resistance of the diaphragm and netting adds 8 h.p., making a total of 28 h.p. The resistance at the ashpan of oil-burning engines is much greater than that through the grates of coal-burning engines on account of the restriction of the air passages in the present methods of construction of oil-burning on locomotives.

Mechanical draft for locomotives has been frequently proposed, and was actually used as early as 1835 by Segiun, the inventor of the multi-tubular boiler. Since that time the experiments made in this direction have been with inefficient fans and comparatively slow speed reciprocating engines for driving them. The great improvements which have been made in the efficiency of blowing apparatus in recent years, and the possibility of driving such apparatus direct-connected by economical steam turbines, render the conditions for success far more favorable. Mr. MacFarland has already demonstrated that it is possible to produce sufficient draft for a large locomotive by the expenditure of 50 h.p. with a mechanical combination of this kind, and is now arranging for special equipment for application to a locomotive in regular service.

WHEEL FLANGE LUBRICATION.

FLANGE lubrication is effective in greatly reducing flange and rail wear on divisions where curves are sharp or frequent; it does not effect the adhesion of the locomotive if properly applied and maintained, and it does not have sufficient effect on train resistance to make it a factor in tonnage rating. These are, briefly, the conclusions of the committee which reported on this subject at Wednesday's meeting. It seemed to be in full agreement with the experience of all the members that have any extensive trials.

General practice favors the application of the lubricant to the flange of the leading driver. It should be of a quality that will form a thin paste which will be partially transferred to the side of the rail head and from there to the flanges of the following wheels. The committee stated that the effect of the lubricant decreased very rapidly as the distance from its point of application increased, but it seemed that this was not sufficient to lead to the recommendation of more than one lubricator on each side of the locomotive.

In cases where the flange oilers have been extensively applied, savings of considerable size were reported by both the committee and the members discussing the subject. Mr. Gaines stated that on a division where all the locomotives were equipped, a saving of at least $50 per locomotive per year is being made from the reduced loss of metal from tire turning alone. The committee reported a net savings of $84 per year per locomotive on one road. It seemed that the mileage of tires between turnings can usually be doubled where conditions are ordinarily favorable to the use of the lubricators and quadrupled where severe curves are frequent. One number reported an increase from 12,000 to 50,000 miles between tire turnings.

The question of the effect of flange lubrication on the brakes when descending long grades brought forth no evidence that any serious result of this kind had been noticed. This feature, as well as the effect on the adhesion of the locomotive, is largely dependant on the proper design and application of the lubricators, but principally on its maintenance. If oil is permitted to get on the tread of the driver or top of the rail considerable trouble with both slipping of drivers and sliding of wheels can be expected.

The question of the effect of flange or rail lubrication on the adhesion of the drivers and, therefore, on the traction power of the locomotive is one which does not appear to have been fully investigated, and it is easy to realize that if this lubrication is not properly controlled it might decrease the hauling power of the engine to a considerable extent.

There seems to be a general impression that if the lubrication is confined entirely to the flange there can be no effect on the adhesion of drivers, but this assumes that adhesion is only obtained by the pressure of the tread of the wheel on the rail head, which is hardly tenable, for where there is wear there is also friction, and driving flange friction on curves must be a part of the adhesion which is essential to traction power.

In the further investigation of the flange lubricator this phase of the question might be considered, and a conclusion as to the real effect of definite flange lubrication on the traction power of locomotives working on curves, as based on dynamometer measurements, should be stated.

Proceedings.

Vice-President Crawford called the meeting to order at 9.55 a. m.

FLANGE LUBRICATION.

The committee reporting last year on the subject of flange lubrication has been continued to make still further report to the 1912 convention and the original committee has been increased from three to five members.

Since closing the 1911 report advice has been received of flange lubricators having been applied by over thirty roads on which lubricators had not been used previously. In most cases reported, the number of locomotives equipped on each road has been small. In one instance, however, a road operating over 1,100 locomotives has applied flange lubricators to the entire number.

On a number of other roads on which flange lubricators were used at the time of preparing the last report, the application

M. H. HAIG,
Chairman, Committe on Flange Lubrication.

has since been extended. The reports of thirty-five of these roads show an average increase of thirty lubricators each, the number per road varying from one to over two hundred.

An affirmative answer to the question "Does your experience confirm the report on flange lubrication presented at the last convention?" was received from twenty-three of the twenty-nine roads replying in detail to the committee's circular. Five of these roads explained that failure to answer was due to lack of sufficient experience.

The types of lubricators applied during the past year indicate the most general adoption of crude oil as a lubricant. Some reports state that hard grease has been rejected as unsatisfactory, due to the fact that the grease catches and holds sand. The abrasive action resulting has increased instead of decreased the flange wear. Graphite as a flange lubricant has been reported as successful by some roads but others have abandoned it for crude oil. Crude oil with a heavy asphaltum base is spoken of with the greatest favor by roads using flange lubricators. It has been successfully applied by both hydrostatic and gravity-feed devices. Exhaust steam from air pumps as well as water jets are still being used to a limited extent by some railways and beneficial results are reported. An undesirable feature of the water jet is the fact that it must be abandoned during the winter weather.

A type of lubricator especially adapted to electric locomotive service has been developed on the Grand Trunk by W. D. Hall, superintendent of power plant and electrical equipment. This lubricator has been designed to meet the requirements of service through the St. Clair tunnel. Fig. 1 is a sketch illustrating the principle by which this lubricator is connected and operated. Oil is contained in an air-tight receptacle of one quart capacity. The oil is led to the wheel flanges by pipes and is sprayed upon the flanges by jets of air. The air is supplied from the main reservoir by a ¼-in. pipe connected to the oil receptacle above the surface of the oil. This provides a pressure to force the oil from the receptacle. A branch of this pipe is connected to the oil delivery pipe leading to the flanges. The oil is thus forced through the pipes and sprayed upon the flanges.

Used with electrical equipment, the air is controlled by an electric push-button. Valves admitting air above the surface of the oil, as well as to the delivery pipes are operated by electromagnets. The push-button is located in easy access of the engineer and oil is sprayed upon the wheel flanges almost

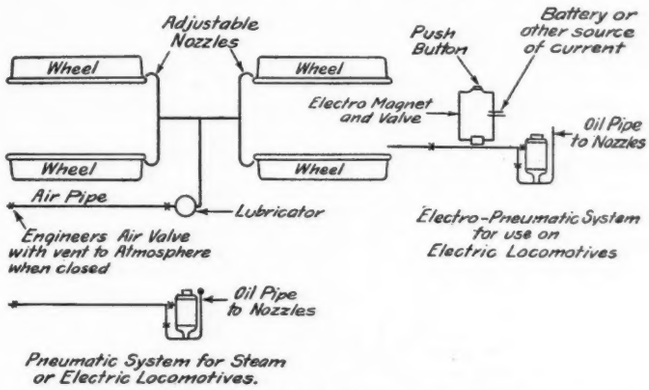


Fig. 1—Pneumatic Flange Lubricator for Electric Locomotives; Grand Trunk.

immediately upon the admission of air pressure. With this arrangement flange lubricant is applied only when needed and when running on straight track the lubricator is not continued in operation.

This apparatus has been in successful operation since July 10, 1910, and has operated under extremely severe conditions. Six electric locomotives have been equipped and handle 1,000-ton trains up and down 2 per cent. grades. Owing to the many curves encountered and also because of the rather slow center of gravity of the locomotives, flange wear has been quite heavy. Since applying this lubricator the conditions have been improved to such an extent that 50,000 miles and over are made between turnings and it is seldom necessary to remove wheels for tire turning before the armature is removed for commutator dressing, and these two operations may, therefore, be performed at the same time.

Before the application of the lubricator, mileage made between tire turnings was from 12,000 to 25,000. The lubricant used is engine oil, most of which is taken from bearing cellars of the railway armatures when the oil in them is being changed. The oil is filtered before being applied to the flange lubricators. No difficulty has been experienced with the delivery of this oil in cold weather. It is sometimes thinned to suit the weather conditions by the addition of a little coal oil. Care has been exercised in keeping the oil free from anything that might obstruct

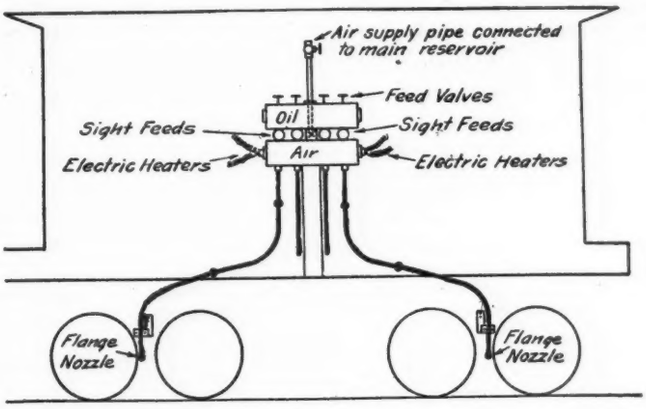


Fig. 2—Electric 4 Pneumatic Flange Lubricator for Electric Locomotives.

the nozzle and very satisfactory results have been obtained under varying and severe weather conditions.

Fig. 2 is a diagram showing the application and principle of operation of an air-operated flange lubricator for electrical equipment, manufactured by the makers of an hydrostatic flange lu-

bricator for steam locomotives. The lubricator is located in the cab as with the hydrostatic device, and sight feeds indicate the rate of formation of the drops of oil. An electrical heater is included in the equipment and the temperature of air and oil is raised by passing through this heater. The air supply is from the main reservoir. Oil is led to wheel flanges by pipes as with the hydrostatic lubricator and is sprayed upon the flanges by air instead of steam. This lubricator is designated by the manufacturers as the "Electric 4." It has been placed in service on electric locomotives of the Baltimore & Ohio and the Pennsylvania.

The Collins flange lubricator illustrated and described in the former report has since been improved. The improved device is similar in construction to that already described. The feeding device of the original type was placed under the body of the lubricator. The lubricating block of graphite composition was pressed against the flange by a pawl engaging in notches in the under side of the block. With the improved type a coil spring and plunger acting directly behind the block of lubricant presses it against the flange, the feed being continuous without adjustment until refilling is necessary. The 1911 report has given the impression that this lubricator was designed to use hard grease. It should be stated that the lubricant is graphite.

Among the simple devices operated by some of the railway companies is one which can be built up of pipe fittings and has been used to apply either hard grease or graphite. The device consists of a short section of 1¼-in. pipe capped at one end and containing a piston actuated by a spiral spring. A small rod threaded into the piston extends through the cap, not only assisting to guide the piston but also indicating the amount of grease in the lubricator. This device is clamped to the frame of the locomotive in front of the drivers and feeds the lubricant directly against the flange. When using ordinary rod grease the lubricant is contained in a section of scrap rubber hose and is deposited as the hose is worn away.

The Pittsburgh & Lake Erie has applied this lubricator extensively, using a mixture of paraffin and graphite as the lubricant. This is contained in a wooden block turned up in a lathe, the cavity for the grease being bored out 1 inch in diameter. The practice of this road has been to apply a lubricator to each wheel which has shown wear or cutting. After the flange has been worn smooth it has not been considered necessary to operate the lubricator until further signs of cutting develop. Some difficulty has been reported as to keeping this device in proper adjustment at all times.

The result of a test of flange lubrication on a number of twelve-wheel locomotives of the Norfolk & Western is contained in the 1911 report. This test led to the conclusion that with track conditions as existing on this line, flange wear was too slight on freight engines to warrant the practice of lubrication. Five Pacific type passenger engines have since been equipped with lubricators for test purposes. The equipment includes three types of lubricators—hydrostatic, gravity and graphite. The comparative mileage between tire removals before and after the application of the lubricators is shown in Table 1. It will be seen that the average service per front tire removed from these engines before the lubricators were applied was 16,518 miles, while the average for the same engines since the lubricators were installed has been 39,909. The former figures are taken from the record of 25 tires removed, the latter from the record of 10 tires removed. The local authorities providing the data suggest that this result may have been affected in some measure by a lateral spring arrangement applied to the trailer trucks to prevent nosing. They state, however, that they consider the improved condition to be due to lubrication and not to the spring.

TABLE 1.

MILEAGE SERVICE OF FRONT TIRES REMOVED FROM PACIFIC TYPE ENGINES TO FEBRUARY 1, 1912.

NORFOLK & WESTERN.

After Equipped with Oilers. Mileage.			Before Equipped with Oilers. Mileage.		
Eng.	Right Side.	Left Side.	Eng.	Right Side.	Left Side.
564	63,141	63,141	564	26,702	26,702
Average miles per tire, 63,141. Tires removed, 2.			Average miles per tire, 26,702. Tires removed, 2.		
569	27,889	27,889	569	13,175	13,175
569	39,582	39,582			
Average miles per tire, 33,735. Tires removed, 4.			Average miles per tire, 13,175. Tires removed, 2.		
571	26,728		571	17,204	17,204
571		43,512*	571	6,845	6,845
			571	12,096	12,096
			571	16,784	
Average miles per tire, 35,120. Tires removed, 2.			Average miles per tire, 12,725. Tires removed, 7.		
572	No tire renewals since oilers applied.		572	15,846	15,846
573	33,816	33,816	572	24,553	24,553
			572	24,297	24,297
			572	14,640	14,640
			Average miles per tire, 19,834. Tires removed, 8.		
			573	17,972	17,972
			573	15,618	15,618
Average miles per tire, 33,816. Tires removed, 2.			573	9,139	9,139
			Average miles per tire, 14,243. Tires removed, 6.		
			Average miles per tire, all engines, 16,518.		

Average miles per tire, all engines, 39,909.

*Includes four months' mileage before oiler was applied.

Fig. 3 shows the contour and mileage records of a decapod locomotive on the Buffalo, Rochester & Pittsburgh. Previous to the application of the lubricator this engine had made 31,529 miles with the flanges worn as shown by the dot and dash contour lines. After making 21,102 miles with a hydrostatic oiler in service the condition of tires was as shown by the dotted contour lines.

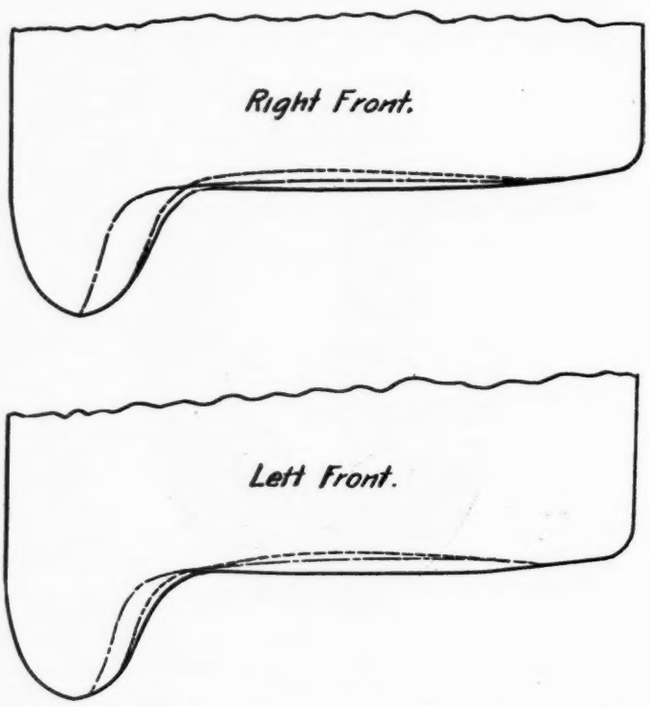


Fig. 3—Tire Contour Taken from a Decapod Locomotive, B. R. & P.

Full lines, standard tread and flange as received new from builders, Sept., 1909, also represents new tires applied July 28, 1910, at which date the Chicago Flange Oiler was applied.

Dot and dash lines, tread and flange July 28, 1910, after making 31,529 miles (previous to applying flange oiler).

Dotted line, tread and flange March 9, 1911, after making 21,102 miles (Engine equipped with Chicago Flange Oiler).

Contours taken from Plaster Paris casts.

The Hocking Valley Railway reports that the service of switch engines operating upon industrial tracks with much sharp curvature has been increased from 4 months to 12 months. On consolidation engines subject to excessive wear of front and back flanges the service of tires has been increased from one year to two years. At the end of this period the flanges are still in good condition.

In Table 2 is shown the estimated saving in cost of fires effected by the use of flange lubrication on the St. Louis & San Francisco. This is based upon experience with consolidation engines equipped with hydrostatic oilers using asp altum oil.

TABLE 2.

SAVING IN TIRES ON CONSOLIDATION LOCOMOTIVES EQUIPPED WITH FLANGE LUBRICATORS.

ST. LOUIS & SAN FRANCISCO RAILROAD.

Value of new 56-in. tire, 3½ in. thick	$30.80
Less scrap metal in tire	2.45
Net value of wearing metal	$28.35
Net value per sixteenth, figuring on 28 sixteenth, wearing metal	1.01

Average loss of metal account flange wear after one year's service if tires have been changed three times	9/16 in.	
Average tread wear	5/16 in.	
Average loss of metal account flange wear	4/16 in.	
4/16 in. at $1.01 per sixteenth		4.04
Loss on consolidation engines, eight tires at $4.04 each		32.32
Cost of changing tires three times		70.80
Total loss account flange wear		$103.12
Deduct:		
45⅝ gallons at 25 cents	$11.41	
Storehouse expense and cost of handling flange oil	2.28	
Interest on flange oiler and material used in equipping engine	5.40	
Total deductions		19.09
Net saving per consolidation engine equipped with oiler per year		$84.03

Comparative mileage of two classes of locomotives of the Queen & Crescent Route is shown in Table 3.

TABLE 3.

MILEAGE MADE BETWEEN TIRE TURNINGS BEFORE AND AFTER THE APPLICATION OF FLANGE LUBRICATORS.

QUEEN & CRESCENT ROUTE.

Consolidation Type.

BEFORE.		AFTER.	
701	22,855	705	44,387
703	18,293	707	43,230
706	16,211	712	51,255
704	26,026	716	45,344
709	25,755	720	42,205
716	25,246	721	43,352
717	24,273	726	40,340
732	18,897	729	44,226
736	24,823	733	42,394
737	27,961	737	43,738
Total	230,335	Total	440,471
Average	23,033 miles.	Average	44,047 miles.

Pacific Type.

BEFORE.		AFTER.	
800, 11-1909 to 6-1909	36,154	800, 6-1909 to 10-1910	76,890
801, 12-1908 to 6-1909	19,743	801, 6-1909 to 10-1910	96,918
802, 12-1908 to 7-1909	46,466	802, 7-1909 to 11-1910	96,470
803, 11-1908 to 8-1909	56,722	803, 5-1910 to 9-1911	97,137
	159,085		367,415
39,771, average before flange oilers.		91,854, average after flange oilers.	

Several roads report a noticeable reduction in tender truck wheel flange wear on engines equipped with lubricators. However, no data have been received to show the extent of reduction or influence upon wheel mileage.

The question of saving in rail renewals and decreased train resistance to be realized from lubrication of rails on curves has been carefully investigated by the Pennsylvania Lines west of Pittsburgh. Tests to determine the reduction in rail wear to be obtained by lubrication were made on curves 3 deg. 20 min. and 10 deg. respectively. The rails on the first half of the curve to be traversed were not lubricated and those on the last half were lubricated by hand. We quote the following from the conclusions of the Pennsylvania Committee: "The data collected shows that with lubrication there would be considerable saving in rail and flange wear on roads with sharp curvature. . . . Our tests confirm a saving but show that for light curvature the saving is very little. The tests show very little more wear on curves up to 4 deg than on straight line."

Records of rail renewal on the Southern Pacific in the Sierra-Nevada Mountains, where all of the locomotives are equipped with flange oilers, show that since the oilers have been in service the average life of the outside rail on all curves above 5 deg. has been increased from 12 months to 32 months, or 2⅔ times the life prior to the use of flange oilers. The average life of the inside rail on curves above 5 deg. has been increased from 13 months to 33 months, or 2½ times the life prior to the use of the oilers.

In this connection it should be stated that rails are now removed having a much smaller percentage of wear than those removed a number of years ago. In other words rails which are now considered unsafe for traffic, a number of years ago would have been allowed to remain in the track several months longer. Keeping this in mind the above figures, which have been abstracted from curve-worn rail reports, will be seen to be conservative.

Attention should also be called to the increase in average daily tonnage. The flange oilers have been in general use on the territory under consideration since May, 1908. For a period of three years prior to that date the average daily tonnage passing over these curves was approximately 15,000 tons. For the three years since that date the average daily tonnage has been 22,000 tons, an increase of 47 per cent. The increase in tonnage should increase the rail wear and in order to get at the actual increase in the life of the rail since flange oilers were put into use, this factor should be taken into consideration. Had the average daily tonnage remained 15,000 tons instead of increasing to 22,000 tons, the rail would have lasted 47 per cent. longer than it did, or practically a period of 48 months. This is nearly four times as long as the life of the rail prior to the use of flange oilers, considering conditions to have been the same in both cases.

Any agency whereby the wear of rail and flanges is reduced may be expected to affect train resistance on curves. This has been observed in the ease with which lubricated engines round curves, but it has not been of sufficient effect to lead to any increase of tonnage rating. It must be considered that the effect of lubricant applied to the flanges of the locomotive drivers decreases very rapidly with increased distance from the locomotive.

The committee of the Pennsylvania Lines, already referred to, continued its tests to determine the effect of flange lubrication on train resistance. A series of runs was made on a division with a grade north-bound of 90 ft. per mile and 60 ft. per mile south-bound.

About two-thirds of the track over the summit is made up of curves from 2 degrees to 6 deg. 45 min. The trains were hauled by a consolidation locomotive. The drawbar pull of runs made with oil lubrication applied to two pair of drivers and the truck wheels, and the runs with graphite applied to the gage side of the rail by brushes was compared with the drawbar pull without lubrication.

North-bound the trains consisted of the dynamometer car and 29 empty cars weighing about 605 tons. South-bound the trains consisted of the dynamometer car and thirteen loaded cars weighing from 915 to 951 tons.

The tests showed a reduction in drawbar pull with a loaded train of 951 tons, of 285 lbs., or about one-sixth of the drawbar pull for one loaded car. The reduction for empty cars was equal to about 1½ cars. The tests were not considered conclusive, however, on account of variable weather.

A similar set of test runs was made over another piece of track as nearly level as could be found with curves from 2 deg. 49 min. to 9 deg. 59 min. This was selected in order to eliminate, as far as possible, any resistance due to grade. The tests showed fairly uniform results and that there was slight decrease in curve resistance due to lubrication, but not sufficient to allow of another car being added to the train.

It is the practice of many roads, where curves occur on grades, to compensate for the curvature by reducing the grade. Where this practice is followed no decrease in curve resistance can affect tonnage rating.

The flange lubricator, like other devices, requires attention. Any defects or any imperfections in the device or its connections should be included by the engineer in his work report at the end of his trip. This work should be done by the enginehouse force and the enginehouse should be held responsible for repairs.

Engine crews should be held responsible for the performance of the lubricators and where repairs are maintained by the enginehouse the lubricators require comparatively little attention. In view of the economy in life of tires when flanges are properly lubricated, road foremen of engines should see that lubricators are kept in operation on the engines under their jurisdiction.

A good location for a lubricator is just opposite to the top frame rail. This should be far enough from the delivery end of the sand pipe to prevent water of condensation from collecting at the end of the pipe and freezing. In severely cold weather care should be exercised to prevent water of condensation from freezing in the delivery pipes of the hydrostatic lubricator. By keeping a sufficient flow of steam through the pipes this should be avoided. This steam can be throttled sufficiently to keep the pipes clear without emitting so much steam as to be annoying.

CONCLUSIONS.

Considering the previous report and the information upon which the present report has been based, the committee feels justified in the following conclusions: The value of flange lubrication depends upon local conditions. Flange lubrication has proven effective as a means of reducing flange wear, particularly on driving wheels. The effect of lubricant applied to driving-wheel flanges decreases rapidly as distance from locomotive increases. Flange lubrication results in considerable saving in rail wear when sharp curves are frequent. The effect of flange lubrication upon train resistance is not sufficient to make it a factor in tonnage rating.

The report is signed by:—M. H. Haig (A. T. & S. F.), chairman; T. W. Heintzleman (So. Pac.); D. J. Redding (P. & L. E.). A. Kearney (N. & W.) and W. C. Hayes (Erie).

M. H. Haig (A. T. & S. F.) presented the report and added the following: The committee reported to the convention last year and in doing so endeavored to cover the situation as fully

as possible, as developed at that time. It therefore now feels that its further duty lies in the recording of the developments in flange lubrication during the last year, the increase or decrease in flange lubrication, as well as reporting the further actual experience of the various railroads, thereby either confirming or refuting the previous report. Since last reporting, there has been some development in the line of flange lubrication for electric locomotives. Two lubricators for this class of work are described in this report. Some impression has been current that the oil used in flange lubricators which use oil as a lubricant, is provided also exclusively from a certain source. It should be pointed out for the benefit of all members that the oil is available in the most convenient market. It has been found, though, from experiment that the Kern River oil from the Bakersfield district of California, is the most satisfactory for the reason that it adheres to the flanges and forms a sort of paste that not only spreads over the flange, but is wiped off against the rail where it forms a coating. In the hydrostatic lubricator, the oil being a heavy body, will not separate when it comes in contact with steam.

Very often information of unusual interest is contained in the letters that the various members forward to committees, and while this information cannot always be given in full in the reports, I feel that a few quotations would be of interest. For instance, with regard to the delivery of lubricant to the rail. A member states that from personal observation in examining the ball of the rail after train has passed, and when the flange lubricator is properly operated on the engine, it is possible to see a slight indication of oil on the rail which he states proves that the ball of the rail was lubricated to a certain extent; a condition which should reduce wear of rail as well as wear of flanges.

Another member in answering the various questions advises that flange lubrication prolongs the life of the rail by one-third, and goes on to state that anything that will save the flanges will save the rail. With regard to comparative wear of flanges between turnings with and without flange lubricators, I refer to a statement made by a member concerning both passenger and freight equipment. He states that engines working exclusively in mountain service require tire change every 8,000 to 10,000 miles when operated without flange lubricators. He then refers to a ten-wheel passenger engine making 37,186 miles before turning tires, and to a Mikado freight engine which made a mileage of 21,152 miles up to the time of a wreck, and examination of the tires and flanges showed them to be good for, at least, 2 months more.

Another member advises that since the application of flange lubricators to a number of ten-wheel passenger locomotives, it has been possible to make from 65,000 to 85,000 miles per engine. With the same class of engine without flange oiler it has been necessary to turn tires on account of flange wear, after making from 25,000 to 30,000 miles. A number of replies indicate particularly satisfactory results with switch engines. Engines of this class work a great deal over industrial tracks in which the curves are sharp and frequent, and various reports indicate that the life of tires is much longer with flange lubricators than without. For instance, one member advises that the service of switch engines is increased from 4 to 12 months.

The committee was particularly anxious to see that all lubricators which had attained any success were described in this report. A short time before closing the report, we received word from one member of the association that he was using a Detroit lubricator. This lubricator is a gravity feed device. The tank is supported under the running board on one side of the engine and a pipe leads to one flange on each side of the engine. The valve which controls the flow of the oil is operated by a ball which receives its motion from the movement of the locomotive.

DISCUSSION.

C. A. Seley (C. R. I. & P.): I cannot understand what the third recommendation means.

Mr. Haig: The lubricator is naturally located on the locomotive. Usually it is located on the driving wheel, though occasionally it has been placed on the engine truck wheel. Instead of stating that the feed of the lubricant decreases as the distance from the locomotive increases, it might have been plainer had we stated that it decreases as the distance from the point of application increases; the lubricator naturally has its greatest effect on the wheel to which it is applied, inasmuch as it spreads the lubricant very fully over that flange. The flange conveys the lubricant to the rail, and as the train passes over that point each wheel picks up a little of the lubricant, so that by the time the last wheel of the train passes that point, it receives less benefit from the lubricant than the first wheel. The object is to spread a paste over the side of the rail, if possible, in order that not only the rail but all of the wheel flanges will receive some benefit.

F. F. Gaines (C. of Ga.): We have tried out pretty nearly everything in the way of flange oilers except the last one referred to by Mr. Haig, and we have boiled the matter down to the hydrostatic form of lubricator as being the only satisfactory lubricator. On one of our divisions we have had quite some considerable trouble, with our Pacific type engines, from the fact that the flanges would run sharp in the neighborhood of about 30,000 miles, practically, whereas after the application of the lubricator we find we can get about 60,000 miles. After equipping these engines with the lubricator, we find we can get 60,000 miles out of them, and figuring on the tire turning and loss of metal involved, and the labor and material, at $250 for each turning, the improved mileage means a very considerable economy, amounting to over $500 between each tire turning on these locomotives.

On another division we equipped the entire system with flange oilers, and our figures, while not showing the saving that some of the roads reporting show, averaged up to $50 an engine per year on this division, although our figures are not yet as complete as they might be, due to the fact that we have only recently got the whole division equipped. We expect to have more definite figures in the future. As an illustration, I will say that the value of tire loss on 8 tires, in the case of engines equipped with the flange oiler, was $74.88, whereas the value of tire loss on 8 tires, in case of engines not equipped with the flange oiler, the loss of material involved is $132.48.

H. C. VanBuskirk (C. & S.): Our road has had considerable experience with flange lubricators of different types, and as Mr. Gaines has just stated, the hydrostatic type of lubricator is the only one, among those we have used, which gives satisfactory results. Our experience has been principally on the narrow gage lines of the Colorado & Southern, where there are long curvatures and high grade lines. There is one question that has been asked, and that is whether there is any effect on the flange lubricator in the case of trains descending on a heavy grade. I can say from my personal observation that there is not. We have tried that with the hydrostatic type of lubricator, by putting sufficient oil on the flange, which will communicate it to the rail, and there is no effect on the braking power when descending on a 4 per cent. grade. There is no noticeable effect. I have tried a lubricator which uses the solid lubricant, and it will pick up sufficient foreign matter so that it will glaze over the surface and give no result on the flange. We have 30 deg. curves, and lots of them, on 4 per cent. grades, and the locomotives in connection with which we are now using the hydrostatic lubricator will run from one shopping to the next, whereas with the lubricator we formerly used, we could never get over 12,000 to 14,000 miles out of our locomotives. At the present time we are running in the neighborhood of 50,000 miles, and never have to take the locomotives out of service on account of flange wear. The gravity type of lubricator that we have been trying will go about 5,000 to 12,000 ft. elevation on one division in warm weather, but by the time we get at the top of a mountain the lubricator will not feed in the same manner, whereas the hydrostatic is under control at all times and will deliver the oil just as it is wanted.

R. D. Smith (B. & A.): The report of the committee at the last year's convention was such as to prompt us in trying these flange lubricators on some of our Pacific type engines; and the results that we have obtained have been very good. I have, however, heard a criticism of it since being here, with which we have not had any trouble, and that is, there is a slippage of the engine when starting a train, due to the spurting of the oil while the engine is standing. I mention this from a hydrostatic lubricator point. The results that we have obtained have been so good as to warrant us in extending their use.

Angus Sinclair: I think I was one of the pioneers in experimenting with flange lubrication. About 1880 I was running a locomotive on a small road. They had only one engine, and the road was very crooked and it ended with a curve of about 15 deg. or so, and I hadn't been running the engine but a short time when I found flange cutting going on. I was aware that if the engine failed, my job would fail, for they would not ever be able to buy another, and consequently I was very much interested in preventing this flange wear. My first natural impulse was to try a swab that we used for piston rods, but that proved unsuccessful as it also lubricated the tread of the wheel. I finally fell upon a scheme of a piece of graphite and grease mixed, and I was fairly successful with that. I was able to prevent the flanges from cutting, and not altogether without lubricating the tread, but still not to any great extent, and I saved my job through the lubricating device, and I was rather proud of it in those days.

S. L. Bean (Santa Fe Lines): We have in my territory about 2,500 miles of road. The longest tangent is 30 miles. We have increased our mileage from 60,000 miles in the passenger

service in one particular mountain district to between 100,000 and 120,000 miles, which is credited to our flange lubrication.

F. F. Gaines (C. of Ga.): Referring to the question brought up by Mr. Smith, relative to the objection to the hydrostatic lubricator on account of the accumulation of water in causing slipping, I would say that as near as we can find out, that where an engine stands for something like 10 or 15 minutes, we have noticed a little slipping in the first revolution or two; but in an ordinary passenger stop or any other stop where it does not exceed 5 minutes, it is practically unnoticeable.

L. R. Pomeroy: In 1886 when I was connected with the Suburban Rapid Transit Company, we had a number of Forney engines that were very much heavier than the type of Forney engine then in use on the elevated system. We had curves of 160 ft. radius, and in running those engines with the leading driver first, we had a great deal of trouble with flange wear, but the greatest trouble we had was the noise made in grinding around the curves. At that time I arranged a piece of ¾ in. pipe, 6 in. long, on the end of which was fastened a felt swab, and the pipe was filled about half full with oakum and a spring on top of it which kept a constant pressure on the oakum, and it was pressed in so hard, that there was no free oil dropped at any time, and yet it kept up a wiping action on the flange which not only relieved the noise, but reduced the flange wear very materially; and that was afterwards placed on all the engines of the system.

Wm. Forsyth (RAILWAY AGE GAZETTE): The fifth section of the report says it has no effect on train resistance, but that is not necessarily a conclusion on the fact of the tractive effort of the locomotive. I have thought that perhaps in the experiments on the Pennsylvania Road where they oil the track on curves, that there may have been some measurements as to the effect of the lubrication of the rail on the tractive effort of the locomotive, *i. e.*, reducing the amount of adheasion.

F. W. Brazier (N. Y. C. & H. R.): I am very much surprised that there are not a good many more men advocating the use of flange lubrication on railroads. It does not make any difference in what direction you save money, and it seems to me that considerable money can be saved in the direction of lubricating flanges. I know that on the Pennsylvania division we run a great many trains on sharp curves. If some device of this kind will stop that wearing away, it will save money in other departments than the motive power department.

Mr. Haig: Replying to Mr. Forsyth; when properly applied, the lubricant is delivered to the flange of the wheel, and is conveyed to the side of the ball of the rail, and should not get on top of the rail. The matter of adjustment, however, has some effect on the hydrostatic lubricator. The oil is delivered through a nozzle and in other form of lubricators, there are various methods of delivering the lubricant to the flange. Now, if these various devices are not properly adjusted and properly maintained, there is a possibility of the lubricant being delivered to the tread of the wheel, and so to the rail. That was a point that we endeavored to bring out in the report, to call the attention of the railways to the necessity of proper adjustment, and by that I mean ordinary adjustment, which is reasonable to expect. Therefore, if the lubricant is properly delivered, it should not reduce the tractive effort of the locomotive. The effect of the lubricant on the flange will not reduce the adhesion.

D. F. CRAWFORD,
President, M. M. Association, and Vice-President, M. C. B. Association.

In reply to the question brought up by Mr. Smith, I note Mr. Smith states that while the question of an engine slipping on starting was mentioned to him down here, in his experience he had not been troubled in that direction. The same statement that I made with regard to the proper application of the lubricant, will apply in answering him also, and I think Mr. Gaines covered that point very well. In regard to the effect of trains descending grades, as touched on by one of the gentlemen present, there has been no difficulty that I know of with regard to the effect on the trains descending grades or the effect on the breaking power. On the road with which I am associated there has been no difficulty of that kind.

Mr. Gaines: For the benefit of Mr. Brazier I might say

that if he will look at last year's report he will find considerable data from the Southern Pacific on the saving of wear on tender wheels. Now, it is reasonable to assume that if you get a noticeable saving of wear on tender wheels that it will be carried back to the rear wheels of the train; of course, to a less extent. It is reasonable to suppose that there is a reasonable saving of wear on all the wheels of the train to a certain extent.

Mr. Flanagan (C. & O.): On one of the divisions of the Chesapeake & Ohio during the last 2 years we have experimented with practically every type of flange lubricator of the gravity feed class, and in some instances we have been using a rubber hose. In the last year we have tested one of the Chicago flange lubricators, using the special oil directed by them, and we have found that the engine on which we applied that lubricator had the tires in good shape after making 4,000 miles, and others after having made about 5,000 miles, and there is no question but that you would be able to run an engine over a greater distance than that. I think another feature that it would be well to consider, although we have not done any experimenting on it, and that is the question as to what effect it has on the tractive effort of a locomotive. One of the experiments that we have made, which is not a new one, is the use of nozzles from the air pump exhaust pipe. I have no data as to the exact amount of wear, but I am satisfied that we will get 3 times the mileage, from our experiment so far, by using that simple method than we do without it.

MINIMUM REQUIREMENTS FOR HEADLIGHTS.

D. F. Crawford: As chairman of the committee on minimum requirements for locomotive headlights, I would say that the committee had no further data of the scientific character presented in last year's report to present at this time. Some of the members of the committee have had experience during the time elapsing since the last convention, in appearing before some of the Legislative committees, and I think it would be very interesting for the association to hear from Mr. Rae, of the Louisville & Nashville.

DISCUSSION.

Clark H. Rae (L. & N.): In the past 6 months, high-power headlight bills were introduced in the States of Kentucky, Mississippi and Louisiana. In Mississippi, the railway did not present their side of the proposition before the railroad committee of the Lower House, and as a result the committee reported the high-power headlight bill favorably, and it was afterwards adopted. In Kentucky and Louisiana, the railways did present their side of the case, and the bills were rejected. Several members of the committee had participated in quite extensive tests of the headlights, and from my experience, verified by the reports furnished to the Interstate Commerce committee, which were afterwards reported in their bulletins of accidents, the high-power headlight is undesirable, especially on railways having multiple tracks and block signal systems or both. From my experience, I don't hesitate to say that at some of the meetings of the Legislatures of the various States, especially in the south and in the west, some of these high-power headlight bills will be introduced. Some of the bills require 300 watts at the arc, some 1,500 candlepower without the aid of reflector, and so on. I trust that this body will go on record that the high-power headlight is undesirable on railways having multiple tracks and block signal systems or both.

F. F. Gaines (C. of Ga.): I would like thoroughly to endorse what Mr. Rae has said. I think we should, as an association, go on record as being opposed to high-power headlight in connection with multiple tracks, and with interlocking or automatic signals, and I would like to make a motion to that effect.

The motion was seconded and carried.

STANDARDIZATION OF TINWARE.

The committee appointed to report on the standardization of tinware, and confer with a similar committee from the Railway Storekeepers' Association, has been unable to collect and compile the data in form to present at this convention. The Railway Storekeepers' committee held meetings in Chicago, December 19, 1911 and March 20, 1912, to which we were invited; unforeseen and unavoidable business engagements prevented Messrs. Poole and Franey attending. Mr. J. C. Mengel attended the meeting of March 20. Another meeting will be held May 19.

J. R. Mulroy, of the Storekeepers' Association, and his committee have prepared a very creditable report. Data which they have gathered from various roads show lack of uniformity in material used, method of construction and dimensions. Some of these affect first cost, others the life of the article. Cans nominally one, two or three gallons capacity have different dimensions and methods of construction on different roads. Some roads dispense with articles which are considered necessary on others.

From the data now collected and with further conference, the committee should be able to recommend standard articles to be used, also standard dimensions, methods of construction, and material which will represent good practice on our railways and standard practice of manufacturing. It is recommended that the subject be continued for another year.

The report is signed by:—M. D. Franey (L. S. & M. S.) and J. C. Mengel (Penna.).

This report was referred to the executive committee.

MAINTENANCE OF SUPERHEATER LOCOMOTIVES.

The committee on the maintenance of superheater locomotives was instructed to consider and report on: The best metal for cylinder and steam chest bushings; the best metal for valve and piston rings, and the best means of lubricating superheater locomotives.

In order to obtain as much data as possible upon which to base its report, the committee issued a circular of inquiry to the members which brought in the following information:

The total number of superheated locomotives in service is 2,222, of which 1,748 are of the fire-tube type and 74 of the smoke-box type. The following types of superheaters are used: Schmidt, Cole, Emerson, Vaughan-Horsey, Baldwin, Jacobs and Vauclain. Of these types, the first 4 are fire-tube superheaters and the other 3 smoke-box superheaters.

As might be expected, the steam pressures and degrees of superheat vary considerably on the various types of locomotives

R. D. SMITH,

Chairman, Committee on Maintenance of Superheater Locomotives.

on different roads, the maximum steam pressure being 220 lbs. per sq. in., and the minimum 150 lbs. per sq. in. The degrees of superheat, that is, the excess in temperature of superheated steam over the temperature of saturated steam at same pressure, varies from 100 degs. F. for fire-tube superheaters and from 10 degs. to 65 degs. F. for smoke-box superheaters. The temperature of superheated steam as used in locomotives rarely exceeds 600 degs. F.

Twelve roads reported that the cylinder and steam-chest bushings on superheater locomotives wear out more rapidly than on locomotives of the same classes using saturated steam, and 20 roads replied that there is no perceptible difference in the wear of cylinder and steam-chest bushings between locomotives using superheated steam, as now operated, and those using saturated steam. All roads reporting increased wear on superheated steam locomotives have superheaters of the fire-tube type.

Fourteen railways report that valve-packing rings of superheater locomotives wear out more rapidly than those of saturated steam locomotives of the same classes, and 17 roads state there is no appreciable difference between the wear of the rings.

Sixteen roads report they have found Hunt-Spiller gun iron

the best metal for cylinder and steam-chest bushings, and one other road intends to use this iron for cylinder and steam-chest bushings of new locomotives. Nine roads state they are using gray iron for bushings, 3 roads use the same metal for the bushings of superheater locomotives as is used for saturated-steam locomotives, and one road is undecided as to the best metal. All the roads favoring the use of Hunt-Spiller gun iron for bushings also favor its use for piston and valve packing rings, and two other roads report using this material for rings but do not use it for bushings.

Eighteen roads use piston-rod extensions and 12 use valve-stem extensions, but 3 of the 18 roads using piston-rod extensions are eliminating them. Eight roads favor the use of piston-rod extensions, 9 favor the use of valve-stem extensions, and 6 advocate the use of piston-rod extensions on locomotives having large and heavy pistons. Eleven roads are opposed to the use of either piston-rod or valve-stem extensions and two are undecided as to their desirability.

Twenty-three roads report there is no unusual difficulty in properly lubricating the cylinders and steam chests of superheater locomotives as they are now operating. Five roads report it is difficult and 3 state that trouble was experienced at first, but the use of a different grade of oil has overcome the trouble. One road using balance slide valve states, it is difficult to properly lubricate the valve, but no difficulty is encountered in lubricating the cylinders. Reports indicate it is no more difficult to lubricate locomotives with smokebox superheaters than to lubricate the ordinary saturated steam locomotive.

Twenty-nine roads are using hydrostatic feed lubricators with entirely satisfactory results. There is but one road using mechanical feed lubricator exclusively. Of the roads now using hydrostatic lubricators, 4 had formerly tried mechanical feed lubricators. The advantages of the hydrostatic lubricator are its reliability, simplicity of construction and ease of regulation as compared with the considerable number of moving parts of mechanical feed lubricators and the tendency of the latter to wear and get out of order.

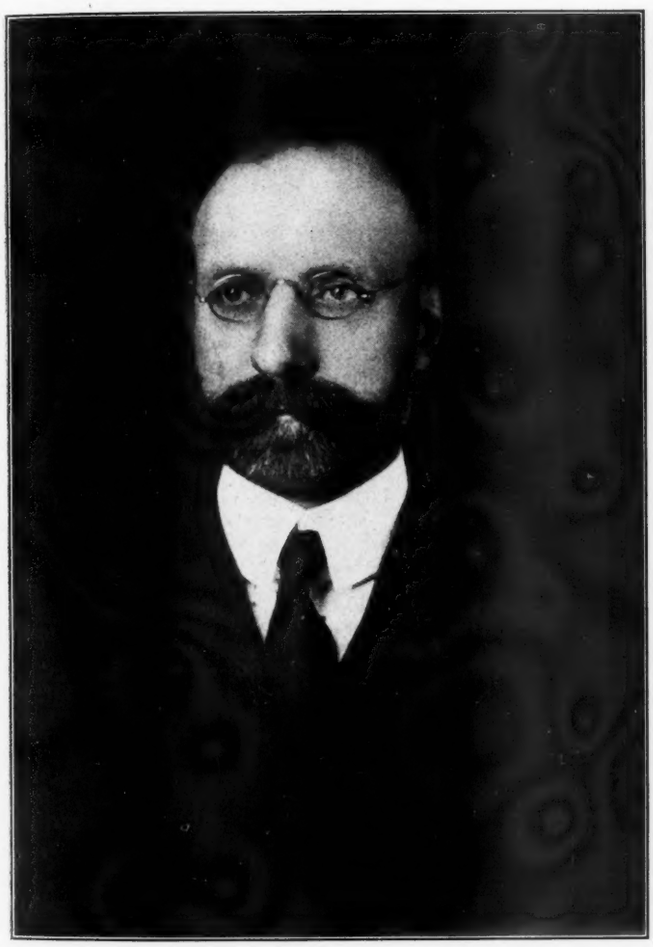
Atomizers are used on 3 roads to deliver oil to the steam chest of superheater locomotives and the results are reported to be satisfactory, but the committee is of the opinion that without atomizers, when the oil is discharged into the steam passageway above the entrance to the steam chest, it is partially atomized, which would seem to be desirable. The replies indicate that no advantage is derived from the use of an atomizer.

There are a number of different arrangements of oil pipes on superheater locomotives and these may be divided as follows: The most common arrangement is that in which the oil is delivered at the center of steam chest and at the center of the cylinder. Another arrangement is that in which the oil is discharged into the steam passageway above the entrance to the steam chest, with an independent connection to the center of the cylinder. Some roads use oil connections to both ends of the steam chest, with an independent connection to the center of the cylinder. A common arrangement, and one that is growing in favor, has a connection which discharges oil into the steam passageway only. It is claimed that the oil is thoroughly mingled with and distributed by the steam. A few roads report having oil connections to the center of the steam chests only.

Twenty roads consider it necessary to lubricate the cylinders of superheater locomotives independent of the steam chest, 8 roads that it is unnecessary and 2 are undecided.

From replies received and from the experience of members of the committee, there seems to be no doubt that an oil connection into steam passageway only, near entrance to steam chest, is the best arrangement for obtaining satisfactory lubrication. It reduces the number of feeds to a minimum and furnishes sufficient oil to valves and cylinders.

The allowance of valve oil per 100 miles for superheater locomotives varies according to type and service. The maximum allowance reported for Pacific type locomotives with fire-tube superheaters is 3.25 pints per 100 miles and the minimum 1.25 pints, the average allowance being 2.25 pints. For consolidation locomotives with fire-tube superheaters, the allowance of oil varies from 2.50 pints to 1.25 pints, the average being 1.75



T. RUMNEY,
First Vice-President, M. M. Association.

D. R. MacBAIN,
Second Vice-President, M. M. Association, and Vice-President, M. C. B. Association.

pints per 100 miles. The average allowance of oil for Mikado locomotives with fire-tube superheaters is 4 pints and the allowance for Mallets is about 6 pints per 100 miles.

The allowance of valve oil for superheated steam locomotives varies in about the same proportion as for saturated steam locomotives, according to type and service. It is customary to allow about 45 per cent. more oil for the fire-tube superheaters than for saturated steam locomotives, while locomotives with smoke-box superheaters usually have the same allowance of oil as saturated steam locomotives.

Twelve roads report using special superheater oil exclusively on superheater locomotives and 13 roads report using the ordinary grade of valve oil, but all the roads using superheater oil report it is more satisfactory, and tests which have been made of the 2 kinds of oil, on superheater locomotives, bear out this statement.

None of the roads report the admission of steam automatically to the cylinders when drifting, but 12 roads report good results from keeping the throttle slightly open when engine is drifting, and this practice seems to meet with most general approval. The use of vacuum valves on superheater locomotives is quite general on American railways, as 23 roads report their use gives satisfactory results and 5 roads report using by-pass valves.

There are a number of different makes of metallic piston-rod packing in use on superheater locomotives, all reported as giving satisfactory service. In general, the same types are used as on saturated steam locomotives, the principal difference, if any, being in the composition of the rings.

The chemical composition of the packing rings is in most cases unknown to the railways, the rings being purchased in finished state from the manufacturers. Where reports are given, a mixture of 80 per cent. lead and 20 per cent. antimony has been used with several makes of packing. Some roads have tried a mixture containing a small percentage of tin, but this has been found unsatisfactory. A widely different mixture containing approximately one-half copper and one-half lead has given exceedingly good results, but is expensive. In general, the preferable composition for packing rings is still largely a matter of experiment.

The committee received a great many suggestions and much information that is embodied in the report. The replies were so general as to indicate that this is a very live subject, and the committee feels that a report based on replies from such a large number of railways may be considered as representing conditions prevailing on practically all the railroads in the country.

SUMMARY.

An analysis of the replies indicates that the results obtained from superheater locomotives have been very satisfactory. It is interesting to note that 5 years ago there were less than a dozen superheater locomotives operating in the United States, whereas at the present time there are about 2,500 locomotives in the United States and Canada having fire-tube superheaters.

Minor difficulties have been experienced on a number of railways; but the great advantages to be derived from the use of superheated steam, such as increased economy of coal and water, increased power, due to the absence of cylinder condensation, the permissible reduction of steam pressure combined with the use of larger cylinders—all obtained without material increase in the size or weight of boiler—leads us to believe that the use of superheated steam in locomotives will increase rapidly.

This being so, it is of great importance to determine the metal best suited for use for bushings and packing rings on modern superheater locomotives, because the use of highly superheated steam increases the difficulty of obtaining proper lubrication, and thus the metal is subjected to more severe working conditions than are usually found with saturated steam locomotives.

It is also important that we know the best means of securing proper lubrication because the efficiency of lubrication has a direct bearing on the life of bushings and packing rings.

A metal suitable for use as cylinder and steam-chest bushings of superheater locomotives should be homogeneous, close grained, tough and of good wearing quality, combined with sufficient strength. It should be tough in order to resist wear, but at the same time it must be of such composition that it can be readily machined.

Replies to the circular of inquiry indicate that Hunt-Spiller gun iron has been used on many railways with excellent results. This is stated to be an air-furnace charcoal iron, and the process of manufacture, combined with proper chemical composition, seems to result in a metal which is well adapted for use with highly superheated steam. The analysis of this iron, obtained by the committee, is as follows:

Silicon	1.40 per cent.
Phosphorus	0.35 per cent.
Sulphur	0.07 per cent.
Manganese	0.49 per cent.
Combined carbon	0.80 per cent.
Graphite carbon	2.20 per cent.

The importance of properly lubricating cylinders and steam chests of superheater locomotives, especially those using a high degree of superheat, can hardly be overestimated, because if proper lubrication is not obtained, many of the advantages derived from the use of superheated steam are offset by continual troubles from excessive cutting of bushings and packing rings, which keep the engine in the engine house when its proper place is on the road.

There seems to be a tendency to use too much oil in superheater locomotives, with the result that there is trouble from the oil carbonizing on the cylinder heads, pistons and steam passages. The deposit of carbon also tends to diminish the life of the metallic piston-rod packing, as it builds up in the stuffing boxes and under the vibrating cups to such an extent that the packing in a short time is forced to carry a part of the weight of the piston rod and piston head.

On certain classes of locomotives, possibly those having pistons exceeding 24-in. diameter, it is considered by some advisable to lubricate the cylinder independent of the steam chest, but in most cases we believe better results will be obtained by eliminating the connection to the cylinders and delivering the oil to the steam passageway.

The committee does not approve of the arrangement of oil pipes in which the oil is delivered near the end of the steam chest, as in this case it is probable that part of the oil is lost in the exhaust, due to the difference in pressure between the live and exhaust steam.

A number of roads report that when superheater locomotives were received from the builders oil was delivered to both ends of the steam chest and to the center of the top of the cylinder; but this arrangement has since been changed so that the oil is now delivered into the steam passageway above the entrance to the steam chest, and the feed to the cylinder has been discontinued. The allowance of oil has also been reduced and it has been found that the locomotives are much better lubricated than formerly and there is a marked diminution in the quantity of oil adhering to the cylinder heads, piston heads and steam passages.

There can be no doubt of the advisibility of using a good grade of mineral oil having a high flash point, for locomotives using highly superheated steam, because the temperature of the superheated steam is sometimes as high as 600 degs. F. A number of the roads state they have used valve oil having a flash point of about 520 degs. and also special superheater oil having a flash point of at least 585 degs., and in every case better results have been obtained from the oil having the higher flash point.

Tests have shown that a moderately high temperature has very little effect on the lubricating properties of a good grade of valve oil when the oil is protected by steam, but when the engine is drifting there is, in most cases, no steam in the cylinders, and the bushings are apt to become hot.

There does, however, appear to be a difference in the results obtained on superheater and saturated-steam locomotives. When drifting the conditions are the same on both, but on saturated-steam locomotives the oil deposit on the cylinders is fluid and the condition of the oil does not appear to have changed; while on superheater locomotives the deposit is gummy and sticky to the touch. This difference may possibly account to a large degree for the rapid wear of piston rings and bushings occasionally experienced on superheater locomotives.

When an engine is drifting a good deal with a closed throttle, there is a considerable vacuum in the cylinders and steam chests, and cinders may be drawn through the exhaust and dirt through the relief valves.

This dirt may adhere to the gummy oil on the cylinder walls and convert them into a lap which will wear away the packing rings and piston heads very rapidly.

This theory explains the good results obtained on locomotives where the drifting throttle has been carefully used and is supported by analyses of the deposit found on the cylinders, which show the presence of cinders and dirt in considerable quantities.

The remedy is obviously to obtain a quality of oil that does not make a deposit of this nature at the temperature to which it is exposed, and to provide means either by ample vacuum or by-pass valves, or by the admission of steam to prevent overheating when drifting.

Many roads use a tandem type of metallic packing on account of the importance of preventing the blowing out of the lubricating oil, which might result in the cutting of the cylinder bushings.

During the past year or two, several alloys have been tried that have given satisfactory results, and while the preferable mixture will vary with the type of packing employed, this question is not now a serious one.

It is important to use a type of piston-rod packing which will stand up under the high temperature met with in the use of superheated steam, and considerable trouble has been experienced

with packing that had proven satisfactory with saturated steam when this point had not been attended to. The melting point of the packing rings should be higher than the melting point of rings usually found on saturated-steam locomotives.

In conclusion, the committee feels that, in order to insure satisfactory results in the operation of superheater locomotives, it is of the utmost importance not only to use the best metals for parts subjected to the action of superheated steam, but it is also important to take all reasonable precautions to obtain proper lubrication.

When superheater locomotives were first placed in operation it was to be expected that certain difficulties would be experienced, but these difficulties have been overcome one by one and we believe that at the present time, with reasonable care in operation and with proper attention on the part of engine-house forces, superheater locomotives will be no more difficult to maintain than saturated-steam locomotives of the classes.

The report is signed by:—R. D. Smith, (B. & A.), chairman; W. H. Bradley, (C. & N. W.); H. H. Vaughan, (C. P.); Joseph Chidley, (L. S. & M. S.), and J. B. Kilpatrick, (C. R. I. & P.).

F. F. GAINES,
Third Vice-President, M. M. Association.

ANGUS SINCLAIR,
Treasurer, M. M. Association.

R. D. Smith, chairman, presented the report in full and after its presentation said:

Since the introduction of superheated steam on locomotives by the Prussian State Railways in 1898, the whole railway world has been much interested in the development of the superheater on locomotives. In the last few years several committees have been appointed by this association to study from different points of view the results obtained from the use of superheated steam on locomotives. If I remember correctly, one of the reports, that which was presented in 1909 which was a very brief one, was in effect that the history of superheating had been gone into very thoroughly, but that the outlook for the future adoption of superheating on American roads looked good, and the committee expressed the belief that there would be a considerable amount of development work along the line of installing superheaters on locomotives. The members of that committee must have been born of prophets, and how well they prophesied is borne out by the fact that at the time they made their report, there were less than 50 superheater locomotives on locomotives, and today, after a period of only 3 years, there are nearly 3,000 and on my way to the convention, I learned from a representative of the superheater company, that they now have under construction something like 1,000 additional superheater engines.

The committee makes some recommendations about what is claimed to be the air-furnace charcoal iron best suited for superheater locomotives, and we give the analysis as furnished us for this iron, which is very similar to that which has been adopted as standard metal for locomotive cylinder castings, cylinder bushings, cylinder heads, steam chests, valve bushings and packing rings in 1906 by this association.

There is a point about the more rapid wear of packing rings that the committee thought had perhaps been overlooked, and that is that the general practice in parting a cylinder ring, is to leave about 1-32-inch opening in the rings. That will do for saturated steam locomotives, but it is found that it is not sufficient for a locomotive cylinder using superheated steam. We need there at least ⅛ inch for about a 20-inch cylinder. I think that is a point that has been overlooked a little, and it may pay some of the members having too rapid wear of cylinder valve rings, to look into it. The committee has been given to understand that the mechanical feed lubricator has been used quite successfully, more so than the information they got led them to believe, and that there are several members here who have had some experience along that line, and would be glad to give these experiences.

The Vice-President: We will consider that the report of the Committee on Maintenance of Superheater Locomotive is received and open for discussion.

DISCUSSION.

C. A. Seley (C. R. I. & P.): I think that the report is an exceptionally good one, and gives information very fully on the very many points which have been covered by the report, although there is one point on which I regret that the committee has not expressed itself in the summary of the report, and that relates to questions referring to the use of piston-rod or valve-stem extensions on superheater locomotives. There is

no doubt of the expense of the application and maintenance of extensions, particularly on piston rods. The location of the device, is one which, in many types of locomotives, materially affects the integrity of the buffer beam, which has to be cut for the rod to pass through it.

On some of our engines which we received with extensions, we have cut off the extensions as a matter of experiment, and while I have not complete information, my impression is that the files show that so far as cylinder wear and other elements of wear are concerned, that there has been no material increase. I would rather favor the valve-stem extension as it is easier to accomplish, very much cheaper to maintain, and it is perhaps more important to effect fine distribution through a longer period of time of maintaining the valve central and without wear, or at least to reduce the wear, but in my own mind I have always seriously questioned the value of the piston rod extension. I know that the opinion is that a very fair majority of the roads or at least a fair number of the roads are opposed to the use of the extensions, as against the number which are using them, or favor the use of the entensions.

C. E. Chambers (C. of N. J.): I note the committee, in framing up the report, made no mention whether snap rings or Dunbar patent type rings were used, and to what extent. It occurred to me there should be less wear with the Dunbar type of ring, and it would also apply to the extra amount of allowance, that would be given to a snap ring, as Mr. Smith stated, ⅛ in., not less than that. The Dunbar type of packing would allow for more expansion without cutting the cylinder.

F. F. Gaines (C. of Ga.): Recently we had a very interesting exhibit and a paper at one of our Railroad Club meetings on the use of oil in connection with superheated engines. The apparatus was very complete, and was so arranged that we were able to see just exactly what happened, how the oil acted with and without steam under these high temperatures, and it emphasized one of the points brought out by the committee as to the value of cracking, the throttle slightly while drifting, so as to always have steam in the cylinder. It was thoroughly demonstrated that as long as there was any steam in the cylinder the oil would not carbonize, but, on the other hand, it would carbonize under these extremely high temperatures if the steam was not present. That not only accomplishes the non-carbonization of the oil, but prevents the cylinder from heating.

While we have not had our superheater engines in service long enough to determine what amount of wear we are going to get with the Hunt-Spiller gun iron, I do feel that we are going to get very favorable results because of several years' experience with the material in our saturated steam engines. Recently, while visiting our chief shop, and in talking with a master mechanic, I asked how he was getting along with his packing rings and pistons, and whether he was still as favorably inclined to the use of that material as his previous reports had shown, and he said: "The best answer to that question is that we have almost forgotten we have a cylinder-boring machine in the shop; formerly every engine coming in for general repairs needed a little truing up, and we have almost done away with the use of the cylinder boring machine."

There was another thing in connection with the lubricating of these engines. At this same Railroad Club meeting, the point was brought out quite effectively, I think, that it is desirable, not only to apply your oil in the steam pipe, but in so doing, to extend the nozzle at least nearly to the center of the pipe, in order to atomize as much as possible of the oil at the moment of delivery. I notice the chairman of the committee referred to the application of the oil where only lubricator pipe has been used, that is, the introduction of all the oil in the steam passage, and I very much wish if any of the members present have been using this device successfully, they would let us hear from them.

C. E. Chambers (C. of N. J.): We have only one superheater engine in service, and that is an Atlantic type, running between Jersey City and Philadelphia. You all know the high speed that the engines make on that division. The oil is piped directly in the passageway, about half way I should say, from the steam chest to the smoke arch, and we simply use a long stem, extending about half way into the middle of the passageway. We had some trouble at the time that we started this lubricator, but it did not amount to very much; the cylinders looked quite dark, not showing any sign of cutting, and did not get the bright effect you ought to have when using saturated steam engines. We have largely overcome that difficulty by simply giving the new metal time to polish up, and so far no bad results are experienced from the one pipe.

It was suggested to us that we should put an additional pipe in the cylinder, but personally I was opposed to it, and I took the trouble to inquire of different roads that had both methods in use, as to the results of their experience, and I convinced myself that I was right in thinking that the steam will be better lubricated by the one pipe going into the passage way.

J. R. Onderdonk (B. & O.): With regard to the lubrication of superheater and the remarks that have just been made, it appears from the tests that we have made so far, that by lubricating the steam, as it were, we get very much better lubrication, both in the steam chest and in the cylinder, than if we attempt to introduce the oil into the steam chest and into the cylinder by several different pipes. By the introduction of the oil into the steam chest, if there is any blow at all, it simply blows the oil out into the exhaust passage, while by introducing it into the steam passage, especially with a bent metal pipe turned in the direction of the passage of the steam, it seems to atomize the oil, lubricating the steam, so that all parts of the cylinder and all parts of the steam chest are lubricated.

Thos. Roope (C. B. & Q.): Yesterday I was very much interested in the remarks made by Dean Benjamin, on the report of the committee, wherein he states that he anticipates a saving of 20 per cent. in fuel. This figure to me seems remarkable, and should greatly assist in the advancement of the superheater locomotives. I agree with the remarks of Dean Benjamin for the reason that on some of our heavy passenger power we have been able to run by coaling stations that before, with the saturated steam locomotive, we were not able to do. That has also been true with water stations, and we have also had the same experience with heavy freight power, which means less labor. We now have about 200 of our largest locomotives equipped with the superheater, and we are adding to that number as rapidly as we can do so. I hope that the time will come when by the use of the superheated locomotive, or some similar device, we will be able to run by or discontinue every other coaling station.

W. C. Hayes (Erie): While the paper itself treats more particularly of the construction of the superheater locomotive and the detail defects that may occur in the locomotive, there is nothing to the report that pertains to the operation of the superheater locomotive, and that is a viewpoint from which I would like to hear the superheater locomotive discussed. There is no doubt that this is one of the questions that is more alive today in locomotive practice than any other one pertaining to large locomotives, and it is being considered mainly from the point of view of the saving that can be made, particularly with regard to the use of fuel, as well as, perhaps, increasing the efficiency of the locomotive to its highest degree. We have, as I said before, no data that will sustain the position that I have had in mind from what little experience we have had with the superheater locomotive, and in seeing these engines in service. The Erie Railroad, with which I am at present connected, has 35 Mikado engines equipped with the Schmidt type of superheater now in service, on one of its heavy operating divisions; it is a heavy, hilly and choppy railroad, and recently the speaker was at a point where he could see the greatest number of these engines in service, so as to see whether or not they were loaded to their maximum capacity. In 4 or 5 days we had half a dozen engines which gave up their trains on account of serious defects that developed in locomotives, so that they were unable to continue further with the load, and had to run in light.

Now, there are certain claims being made as to the savings that accrue from the use of superheater locomotives. Figuring on that from a purely fuel standpoint, and admitting the allowance that the superheater people claim for locomotives equipped with a superheater, say a 20 or 25 per cent. saving, if we figure the value of a locomotive at about what operating people generally do, it occurred to the speaker that the saving in all directions and increased efficiency of the locomotive also, added to that of the fuel which might be saved, would be more than absorbed in the cost of the maintenance of the superheater.

Now, if that is true, that is a serious phase of the superheater problem. If that is not true, and the defects that have been thus far developed can be remedied so that they will not recur, and you can keep your superheater locomotives in operation continuously and constantly, then no doubt it is one of the greatest savers, both in fuel and efficiency of the locomotive, that has struck the American railroads to-day, and it is a result well worthy of all of the best efforts that can be put forth in its advancement.

Mr. Seley: I would like to answer the last speaker in some measure, at least, perhaps, from our own experience. The records of this association will show that the Rock Island road had the greates number of superheating engines of any road in the country for several years. True, it was a small number of engines when compared with the superheater engines in use across the border, but so far as the States are concerned, we had superheater engines in advance of the other railroads in the

States for two or three years, and soon after obtaining them I was very frequently asked how much superheat we obtained. I said, "I do not know," and I did not care very much, the principal point was to overcome the very difficulty which Mr. Hayes speaks of and to have a practical road proposition. I will admit freely, that we did have quite a little trouble with the superheater at the start. It was of a type which has been found not to be of the best in its detail arrangement, and important changes had to be made, as well as attention given to a number of relatively less important matters of detail in the construction, so that it took 2 or 3 years to work these engines up to a practical road proposition, to a point where we did not know that the superheater was on the locomotive.

I feel convinced, from the large proportion of superheaters which we now find being constructed in the shops of the locomotive companies, that the roads generally have overcome, to a great extent, the early troubles. In our own case we have gone on, and with an improved form of superheater in our later engines, we are securing very admirable service. So far as the question of economy is concerned, as compared with the saturated steam engine, I am not able to say from our own records. We have about 60 superheater engines, but they are all passenger engines except one, and that has a front end superheater which is not comparable in performance with the others. I will say this much, however, as testimony in regard to a comparison which was given to me by our friend, Mr. Quayle, who is not present, although admirably represented; in conversation he stated to me that they were giving their superheater consolidation engines a 10 per cent. greater tonnage rating than the equivalent size non-superheater engines, or saturated steam engines, and with that 10 per cent. greater tonnage rating, they were also getting a 25 per cent. coal economy. I presume that those are regular road figures, and are not a test performance, as I do not think Mr. Quayle would make that statement unless he was very fully assured of its being a regular performance.

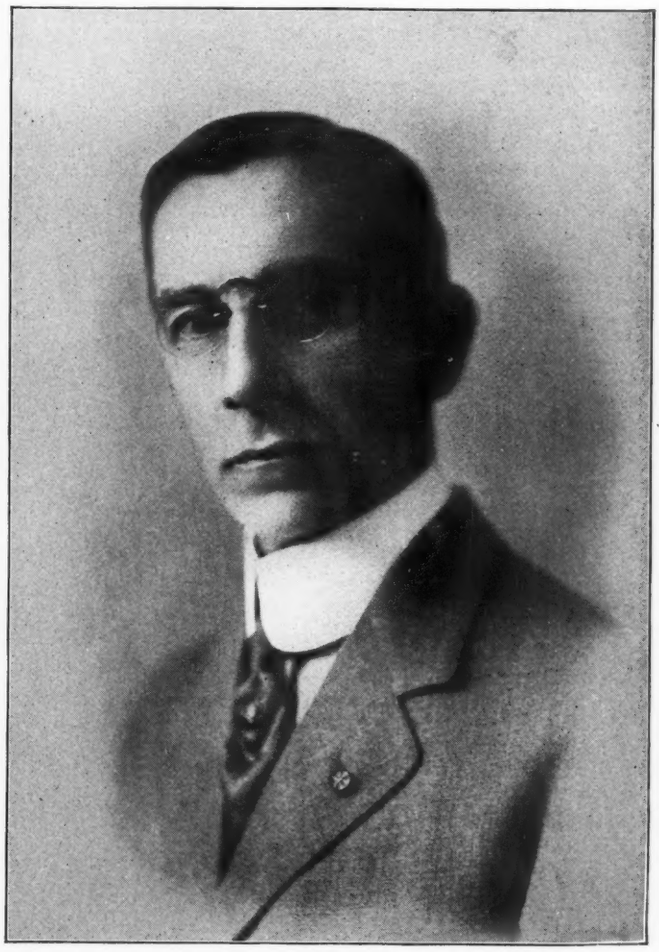
J. A. Pilcher (N. & W.): I wish to ask Mr. Hayes if he will state the nature of the trouble he experienced. We have had a number of superheaters recently installed, and the general performance has been very satisfactory. We have no exact data yet. I would like to know just what the trouble is with these superheaters and the type of superheater.

W. C. Hayes (Erie): In answer to the gentleman's question, I would say that the troubles occurring on the engines to which he has just made reference, covered a variety of things, leakages in the superheat tubes, in the headers and things of that character, so that the engine would not steam, and had to give up its train on the road, which to my mind would make the superheater a very expensive engine to operate when all things were considered. The Schmidt type of superheater is used on several passenger engines of the Pacific type, the largest type of engine we have in service, and which individually give a very good account of themselves, making a magnificent saving. But when you take the whole general proposition into account so far, after an experience of 6 months with 35 engines, we have not been able to see any saving, as compared with the consolidation, which is prior to the introduction of the Mikado.

S. L. Bean (A. T. & S. F.): I would like to inquire if the members have experienced troubles from the smoke tube breaking at the contracted end or the fire-box end of the tube; also the valve-stems and piston-rod packing blowing out on the road.

W. S. Morris (C. & O.): We have running daily 25 machines on the division which come directly under Mr. Murray's charge. Last year we took some special interest in the saving of fuel on this particular division, and the comparison so far as fuel is concerned, showed a saving of from 18 to 26 per cent. as compared with the engines that we used the previous year which were saturated steam engines. These 25 engines have the following general dimensions: The total weight is 400,000 lbs., weight on drivers, 337,000 lbs.; the maximum tractive effort, 78,200 lbs. They have developed a fuel economy as high as 43 per cent. per fuel ton mile, and I am very much pleased and encouraged with the remarks of Mr. Murray, which indicate that the reports appeal to him, and I am quite sure with the strenuous economical conditions that we have had to contend with on

C. E. FULLER,
President, M. C. B. Association.



M. K. BARNUM,
Vice-President, M. C. B. Association.

our road for some little time, the maintenance of these 25 Mallets was particularly good. Therefore, I am inclined to believe that Mr. Haye's troubles would possibly be little as compared with the great subject of superheat.

Mr. Pilcher: In making these comparisons, did you compare a compound superheater Mallet with a consolidation type?

Mr. Murray: Yes, those were comparisons.

J. A. Pilcher: I would like to ask Mr. Hayes what type of joint, whether a flat joint or a ball joint, and did they give trouble?

Mr. Murray: I want to say for the information of Mr. Pilcher that we practically have the same trouble with leaky joints, and we reduced that entirely.

C. D. Young (Penna.): The Pennsylvania Railroad have not had very long experience with a high degree of superheat on locomotives. Some few years ago they tried a low temperature superheater, but it did not prove very satisfactory, and it was not until about a year ago that investigation was made into the application of superheated steam to our equipment. I believe today we have something over 200 engines either on order or in service, and our experience has not been long, although it has been rather curious in the last 5 or 6 months. We have not had, considering the rapidity with which the engines have gone into service, a great deal of trouble; our troubles were largely confined, not to the superheater, but to the things incident to the application of the superheater, *i.e.*, the proper lubrication, and the proper material for bushings, and packing rings. A careful investigation of the conditions bringing about train detentions or troubles on the road, due to lubrication and packing rings, developed early the fact that it was largely in the handling of the engines, more than in the actual material that was being used, and I feel that the committee have fully covered this situation in their investigation where they say that some steam must at all times be passed through the cylinders in order to obtain good and sufficient lubrication. We at the present time are making a rather careful investigation of the details as to materials and methods of operating the superheater locomotives, and it may be of interest to the committee to know just what we have been doing. I may say first that we have found that it is hardly necessary to lubricate within the cylinder. Our practice at the present time is to put what we call an atomizer on, which is simply a 3/64 in. hole, shaped the same as a nozzle of a viscosimeter, back about 22 in. from the piston valve in the smooth passageway. This seems to give us the best results of any method of lubrication so far as applying the lubricant is concerned. The cylinder lubricant has been omitted, and we have found that the lubrication seems to be better, if anything, with simply one oiler admitting the oil well back of the valve. We have had some experience with hydrostatic lubricators which has not been entirely satisfactory, largely due to conditions of chokage, I believe, and the condition of the oil pipes. I believe I am safe in saying, from our length of experience, that the superheater locomotive is exceedingly sensitive to anything that is slightly wrong. That same condition might exist on a saturated engine, and the engine will go along and do its work daily without giving any trouble. But if that same condition exists in a superheater engine, you can look for trouble pretty quickly. We found trouble from choking in the hydrostatic lubricator at two different points. For instance, at the lubricator, and in the steam passageway down to the valve. If the oil pipes have some slight obstruction in them, trouble will be experienced, and it seems to me desirable and almost necessary to have constant lubrication at all times when running. We recently made some experiments at the locomotive test plant to determine what the temperatures in the valve and valve bushings and cylinders amounted to, to see where most of the trouble originated. The results of these experiments have not been entirely worked out, but the indications are that the average temperature of the valve bushing is only about 93 per cent. of that of the steam in the steam passageway; whereas, the average temperature of the middle walls of the cylinder is as low as 55 to 60 per cent. of the temperature of the steam, showing a very considerable difference between the temperature of the metal in the valve bushing, as compared with the piston and the cylinders. That would seem to indicate to me that careful consideration should be given to design and materials in the valve, in the bushings. The committee has touched upon the necessity of tail rods, and I am inclined to feel the same way that Mr. Seley does, that an extension rod on the piston is not necessary, however, if we are to have 300 lb. valves, it would be necessary to obtain good service.

There has been nothing mentioned whatever about the relative merits of locomotives, equipped with superheaters having dampers, and those not having dampers. The practice seems to vary in that respect, and I would like to ask some of the members if they would give me an expression of opinion as to the necessity or value of the use of a damper or its elimination. I would make a motion that the committee be continued and asked to report next year on the construction and operation of the superheater. I think it is about the liveliest subject we have at the present time.

Mr. Pratt: We had 2 superheater engines that were very much coddled and babied for about 2 years. One was an Atlantic type engine, and the other was one of our largest freight engines. After a while we gradually lost sight of them. However, since that time we have progressed quite rapidly along that line and have nearly 200 superheater locomotives of the consolidation and heavy Pacific types. As fast as the saturated steam engines of the same class pass through the shops for heavy fire-box work, they are changed to superheaters. We use the Schmidt fire-tube heater altogether. We have no trouble with the back end of the small superheater pipes, as some one asked, and lately we have had very little trouble with the joints leaking. That is perhaps our worst difficulty on the start. I don't think our men knew how to make a proper joint, and I am quite sure the builders did not know. We have found some cases of poor results with superheaters, especially in passenger service, that upon investigation proved entirely due to not keeping the large tubes cleaned out, and from our experience I would urge that with this type of superheater careful inspection be made by responsible men.

We have not thought it was necessary to use the extended rod, although we have a limited number and are trying them out to learn which we will finally adopt. We have had but a few cases of the rod-packing melting, and I don't remember but one or two cases in the last year where an engine had had to give up a train for that reason. The use of cylinder feeds is still a question with us. We would rather spill oil unnecessarily than have trouble with rod, and we do use the cylinder feeds quite largely. Some of the master mechanics have cut them out, and are having good results; and, personally, I don't believe that they are necessary, but they may be an added precaution. We have the feeds run into the steam chest at various points, with all the piston valves. Some of the feeds are split and the oil is fed over the traveling rings, which apparently is a little better than fitting it over the center of the spool. I would like to emphasize what one gentleman has said with regard to the avoidance of drifting with a superheater locomotive. I believe it is advisable to avoid drifting on a saturated engine. With the skill and practice of the men in avoiding drifting, we find that we can take the release valves off. We have done so on a large number of engines, and there is no doubt in my mind that if you can depend upon the engine men, that the relief valve is unnecessary; also the air drawn through the relief valve is very likely to carbonize the oil. It is only natural that with the high degree of temperature, great dependence must be placed upon regular lubrication, and we have come to believe that that is perhaps the secret of successful operation more than the amount of lubrication. With a saturated engine, we all know that frequently they fill the lubricator on the road, after which it takes from 15 to 20 minutes to get the oil to the parts to be lubricated. With a superheater engine, that won't do. We have got to have regular feed. On the night runs we have found it most advisable to give the engine crew a light back of the lubricator feed, so that they may know what they are doing at all times. It is with a good deal of satisfaction to me that the reports of careful tests indicated that a lower steam pressure may be used on superheater engines than we have been using on the saturated engines, and I rather regret to see these superheater steam pressures going up to 200 and 220 lbs. We know the lower steam pressure reduces our boiler troubles very greatly, and still it may be necessary to get such a large pressure in order to give power to some particular locomotive. I don't believe that this is necessary on all roads or on all classes of service, and I have a feeling that we should keep our pressures down as much as possible. One gentleman has just suggested that I say a word with regard to some tests that were conducted on our runs between Chicago and St. Paul with superheater engines, because that emphasizes decidedly the fact that the superheater engine is most efficient when worked to its maximum capacity.

The trains upon which these engines were tested were much heavier northbound than southbound, and if I remember rightly the northbound economy would pay for the extra cost of the superheater in between 2 and 3 months, whereas the southbound economy was less than one-half of that obtained on the northbound trips. The use of dampers is something we have never abolished, except when they froze up last winter. Damper cylinders froze up somewhere about every 24 hours on the road and we changed the cylinders from horizontal to vertical, so that this would be avoided. We didn't get it patented so that you can all use it. I understand there are several roads represented here that have used an improved form of plug valve for superheater engines, and it would be interesting to me and perhaps

others if they would advise us if they are giving entire satisfaction.

M. K. Barnum (Ill. Cent.): We have about 125 superheater engines in service, and they have been remarkably free from troubles. They have been now in service about a year, and much to my surprise, everyone that has had anything to do with them has been enthusiastic over their performance, and several of our master mechanics who have had them under their supervision expressed the opinion that they would cost less for maintenance than the saturated steam engines of anything near the same power. These locomotives have rather more power than any of the simple engines on our road. We have had no trouble whatever from piston rod packing. We are using a type of piston packing which has the perforated holes in a curve in the face of the ring, and they are having comparatively no trouble with it cutting the cylinder.

This packing was developed on our road with the sinple engines before we got the Mikado, and w s tested first in one of our enginehouses where we had a conso idation engine that was very severe on the cylinder packing, so much so that the packing had to be renewed every week. I omitted to say that this was a snap-ring packing. In the case of this experimental engine, the packing ring was applied, and where the engine had been requiring new packing for about every 700 or 800 miles, it ran 55,000 miles, and was replaced when the engine went into the shop. We have been using the dampers in our engines and believe them to be essential to the proper operation of the superheater. We have had a little trouble with the superheater headers breaking, which seems to be due to shrinkage cracks, and that has occurred in only, I think, 3 cases out of 125 engines. That, we believe, will be overcome by modifying the design. We use a ball joint between the superheater elements or units, and the header, and have had very little trouble. In one or two cases the bends have broken, which was apparently due to the bends having been drawn up too tight, or not properly adjusted when the engine was built. This has been limited to so few cases that it appears to have been simply inaccurate workmanship and not a fundamental fault. We will probably have about 200 superheater engines in service by the last of this year, and we have no doubt whatever as to their success. We are getting about 20 per cent. fuel economy, and about 25 to 30 per cent. present economy of water, and we are able to run water tanks regularly, where formerly the locomotive had to stop.

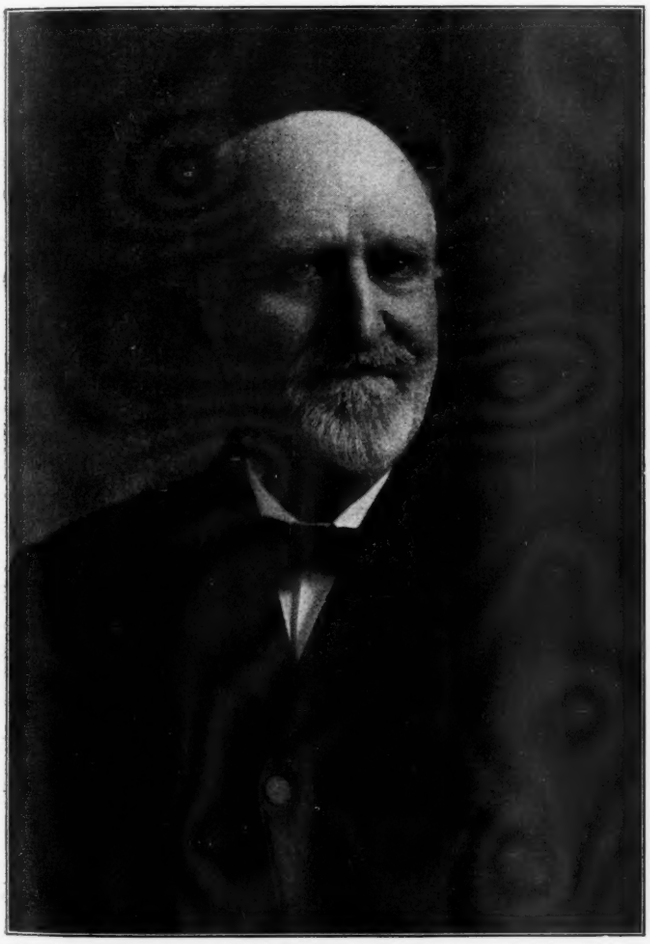
M. Flanagan (C. & O.): The gentleman who has just spoken made mention in regard to the packing. If there is no objection, I am satisfied it would be of benefit to all the members of the association if a sketch could be made of that packing and it can be shown in the proceedings. I hope some arrangement can be made by which it can be done.

M. K. Barnum: I would be very glad to show the packing. It is very nearly identical in design that the Northwestern are using, and it has been very satisfactory. I have had experience with it for something over 12 years.

J. F. DeVoy (C. M. & St. P.): Mr. Pratt of the Northwestern said, which was true, that the highest economy is obtained from the superheater while it was working at its fullest capacity. The only condition I have to add is that where the water is bad the superheater engine acts much better than the saturated engine for the water carried through the throttle is evaporated while going through the superheater tube. I am led to believe that possibly 15 to 40 per cent. can be obtained in ordinary service with ordinary water, and I am ready to believe that in a bad water district, that perhaps as high as 30 per cent. over the present practice can be obtained in a non-superheater engine.

Jas. Chidley (L. S. & M. S.): I want to say for the Lake Shore, that we have removed the dampers and the plates back of the diaphragm. Of course, our road is a low-grade road, and not as much driven on as the Pennsylvania or some higher grade road.

D. J. Redding (P. & L. E.): One gentleman referred to the fact that it seemed necessary to maintain constant lubrication in order to have successful operation. That does not seem to have been threshed out. I think it might be possible to hear from some of the other roads to see if they



J. S. LENTZ,
Treasurer, M. C. B. Association.

J. W. TAYLOR,
Secretary, M. M. Association and M. C. B. Association.

got any better results from the hydrostatic lubricators. We have two superheater steam engines, and all I hear is that the injectors cannot be cut down often enough and the firemen don't get enough exercise shoveling coal.

T. R. Cook (Penna. Lines): Our experience is very meager, and what I say must be taken with a grain of salt. We have engines on our lines that are equipped with superheaters, but I have no information as to the comparative results obtained with the tube type of lubrication. We have had, though, some experience with the 4-speed lubricator, which seems to indicate the necessity of constant and sure lubrication. It was found that the pressure in the choke blocks when the engine stopped dropped very rapidly, dropped down in a short time to 20 or 30 lbs., and it took a number of minutes to get that pressure up again so that oil would be delivered to the parts to be lubricated, and by changing the choke blocks and experimenting with them we have been able to get a choke block that will hold the pressure, so that in the ordinary stops there is no lack of lubrication. As soon as the engine starts the oil begins to feed to the steam chest. As to the location of the pipes, the original installation had a tallow pipe in the cylinder and one in the steam chest, and our experience seems to indicate that we did not get any benefit from the lubrication of the cylinder, and the best location of a single pipe is in the steam passageway—not as to a question of atomizing the oil, but as to putting the oil where it will go to the parts to be lubricated.

R. D. Smith (B. & A.): The matter of extension pistons and valve-rods was discussed in the committee before the circulars were brought out, and while it was not anything the committee were directed to look into, they did think that it was closely allied, and they therefore asked the question, and found that they were not looked on with great favor. We didn't get reports but from very few that were using Dunbar packing. I don't think anybody reported using it exclusively on any type of engine. The spring ring form seems to be that most generally used. The suggestion of using lower pressures seems to me to be a most excellent one, and one that I think we would all aim to follow, providing always that the clearances were sufficient on some of the roads. That is quite an important feature. We are surprised at the experience of Mr. Hayes. Mr. Hayes was evidently looking for trouble and found it—or rather, he was looking for trouble, but perhaps the suggestion might not be amiss to him that he was looking in the wrong place for it. If he had gone to the engine house instead of to the superheater engine, his troubles might have disappeared. Like all devices when new, the superheater engine gave us some troubles. We rather expected them. We started in with a superheater engine looking for trouble, and we have been looking for trouble ever since, and we haven't found it; and the answers that this committee received to some of the questions were very full, and we feel warranted in saying what we have said in the report, that a superheater engine will cost no more to maintain than a saturated steam engine of the same type.

ENGINE FENDER WHEELS.

Action was deferred on the this report until definite action was taken by the M. C. B. Association on car wheels.

The Vice-President: Mr. Seley's motion is that this association do not provide for recommended practice, but simply as a standard. Therefore, in view of that, I would suggest that Mr. Seley move an amendment to Mr. Gaines' motion. Will Mr. Gaines second it?

Mr. Gaines: I second the motion.

The motion was carried.

CONCLUDING EXERCISES.

The usual resolutions thanking the technical press, particularly the RAILWAY AGE GAZETTE, were adopted.

The following officers were elected: President, D. F. Crawford, (Penna.); first vice-president, T. Rumney, (C. R. I. & P.); second vice-president, D. R. MacBain, (L. S. & M. S.); third vice-president, F. F. Gaines, (C. of G.). Executive members, terms expiring 1914, G. W. Wildin (N. Y., N. H. & H.), C. F. Giles (L. & N.), and William Schlafge (Erie).

Scott H. Blewett was delegated to hand the ex-president badge to President Bentley.

It is proposed to extend the Laokai-Yunnan line, China, to Luchow.

DAVID FRANCIS CRAWFORD.

David Francis Crawford, the newly-elected president of the American Railway Master Mechanics' Association, was born at Pittsburgh, Pa., in December, 1865, and was educated in the common schools and at the Pennsylvania Military Academy at Chester, Pa.

In 1885 he entered the shops of the Pennsylvania Railroad at Altoona as an apprentice, and continued there until 1889, when he was appointed inspector of the test department, holding this position until February, 1892. He was then sent to Fort Wayne, Ind., as assistant master mechanic, and continued as such until 1895. This was followed by a promotion to the office of assistant superintendent of motive power, which he filled until 1899, when he became superintendent of motive power. In 1903 he was appointed general superintendent of motive power of the Pennsylvania Lines West, with headquarters at Pittsburgh, where he is still located.

This outline of Mr. Crawford's career would give but a faint idea of his activities without some account of the related matters with which his name is associated. While superintendent of motive power at Fort Wayne he was in responsible charge of designs and construction of a number of electrical power plants which probably paved the way for his appointment on the committee in charge of the electrification of the New York terminal, as well as that charged with the designing of the electric locomotives in use at that point.

Of course, during the whole of his career he has been closely associated with locomotive and car development on the Pennsylvania Lines West. Probably the most spectacular piece of work, and one which has attracted the greatest attention, is the designing of the heavy Pacific locomotives, used on heavy fast passenger service, upon which the men have bestowed the sobriquet of "Fat Annie." At the time of its construction the "Fat Annie" carried the heaviest load on the driving wheels of any passenger locomotive. This weight was 29,500 lbs. The engine was built as an experimental machine to provide for the future increase in train weights, and after three or four years of preliminary trial, has been ordered in considerable numbers.

Another matter with which Mr. Crawford's name is associated is that of the development of the underfeed mechanical stoker. This was a work to which he devoted a great deal of close personal attention for a number of years, and has succeeded so well that the machine is being rapidly applied to the locomotives of the Pennsylvania system, both east and west.

Outside the immediate work of his department, Mr. Crawford has been very active in supporting the railway position before the several legislative bodies that have had matters under consideration for the supposed benefit of the public. Two years ago he was one of the strongest opponents of the federal boiler inspection bill, which was under consideration at the time. He was also in the forefront of the struggle regarding the safety appliance act, which resulted in exclusion from its provisions of a number of objectionable features.

About two years ago the Indiana state railway commission issued an order to the railways of the state that all locomotives should be equipped with what was interpreted by some to mean a high, powerful headlight. Mr. Crawford was largely instrumental in having an elaborate investigation made as to the actual working of such a headlight, an investigation which resulted in the courts declaring the order void.

Mr. Crawford is a member of the American Society of Mechanical Engineers, of which he is one of the managers; the Institute of Electrical Engineers, the American Society for Testing Materials, as well as the local railway clubs and, of course, the Master Car Builders' Association. He is on the committee of maintenance of the American Railway Association, and of the statistical committee on railway account-

ing of the same association, on which he is the representative of the Pennsylvania Railroad.

While these do not cover all of the activities in which Mr. Crawford is interested and engaged, they will serve to show their wide range and the position which he occupies in the railway business.

R. S. M. A. EXECUTIVE MEETING.

At a meeting of the Railway Supply Manufacturers' Association, held yesterday morning, John D. Conway was re-elected secretary. A resolution was also adopted to consolidate the offices of secretary and treasurer, which resolution will be submitted to the members and voted on by letter ballot.

M. M. HONORARY MEMBERSHIPS.

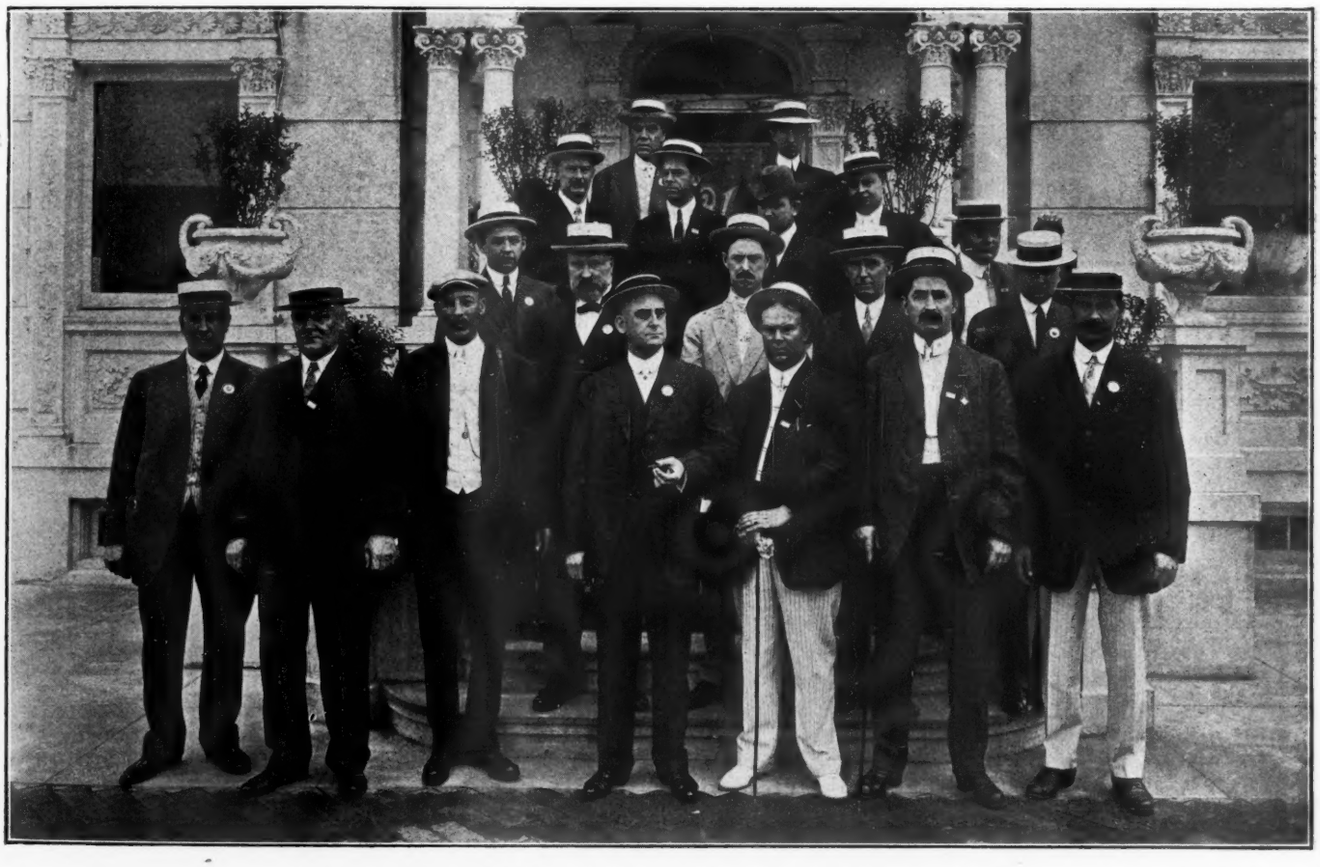
W. T. Smith, formerly superintendent of motive power of the Chesapeake & Ohio, and now retired, was yesterday elected an honorary member of the M. M. Association. Mr. Smith has been a member of the association since 1869, making a period of 43 years.

MR. BENTLEY'S CONDITION.

E. W. Pratt made the following statement in the convention yesterday:

"Mr. Chairman and Gentlemen—I have just come from Mr. Bentley's room, and I think you will be glad to know that the doctor who is there says that he can in all probability get out of bed to-morrow, and within a day or two after proceed home.

"I did not know that I would be called upon to make any expression for Mr. Bentley, and have not been delegated to do so, but I want to assure you that he said over and over again if anyone could be killed by kindness, he believes he would be dead by this time, he has had so many kind inquiries, direct and indirect, from the members of this association, and others, and I think the sympathy and feeling we have had in our hearts has got to him in other ways. He feels very grateful to all of the members for the very large attendance at this meeting, which was a matter which was very dear to his heart; for the very thorough discussion of the papers, as others and myself have told him that it was a good convention, and that we had not any of us overlooked



FORMER EMPLOYEES OF THE CHICAGO & NORTH WESTERN.

Top row, left to right—F. W. Peterson, Master Mechanic, Chicago & North Western; G. F. Slaughter, American Steel Foundries.

Second row from top—B. R. Moore, Superintendent Motive Power, Duluth & Iron Range; M. C. Beymer, American Arch Company; J. A. Kinkead, Parkesburg Iron Co.; John L. Nicholson, American Arch Co.

Third row from top—F. M. Whyte, New York Air Brake Company; George R. Henderson, Consulting Engineer; George L. Bourne, Locomotive Superheater Co.; Henry D. Kelley, Goldschmidt Thermit Company; John P. Neff, American Arch Co.; John T. Carroll, Assistant General Superintendent Motive Power, Baltimore & Ohio.

Bottom row—G. W. Kelly, Master Blacksmith, Central Railroad of New Jersey; George Wagstaff, American Arch Company; W. G. Wallace, American Steel Foundries; Edgar B. Thompson, formerly Superintendent of Motive Power, Chicago, St. Paul, Minneapolis & Omaha; E. J. Arlein, W. H. Coe Mfg. Company; J. W. Kelly, National Tube Company; J. A. MacRae, Mechanical Engineer, Michigan Central.

the part, the very active part, which he played in the planning and preparation of the convention this year.

"Mr. Bentley also wanted me to thank, which I have done, individually the presiding officers of the convention, and it is unnecessary for me to say that he regrets very deeply that he should have been unable to preside, and I know we are sorry, too, because of his well-known enthusiasm and vigor in all matters connected with the administration of the affairs of the association, that he is unable to be with us." (Applause.)

A 600-1200 VOLT DIRECT-CURRENT FREIGHT LOCOMOTIVE.

A standard gage electric locomotive weighing 94,000 lbs. has recently been added to the rolling stock of the Oakland, Antioch & Eastern for handling freight trains. This system when completed will make a net work of lines totaling about 156 miles in the vicinity of Oakland, Calif.

The mechanical parts of this locomotive were furnished by the Baldwin Locomotive Works, and the electric equipment was furnished and installed by the Westinghouse Electric & Manufacturing Company. It is of the double truck type with raised center cab, and is arranged for operation in either direction. It can traverse curves of 50 ft. radius when hauling a trailing load.

The trucks are of the equalized pedestal type, with one-piece forged iron frames and rigid cast steel transoms. The transom gussets have ample bearings on the frame and transom, and act as brake lever guides and brake shoe hanger supports. The brakes are inside hung, and are applied through a radial beam, which is supported on the inner end of the truck frame. The wheels have cast iron plate centers, with steel tires shrunk on and bolted.

The locomotive frame is of the built-up type, composed of commercial shapes as far as possible. The longitudinal sills are four 12 in. channels. Between the middle and outer channels there is, on each side, a strong arrangement of diagonal braces of 6 in. channels. The end bumpers are of steel plate, ⅞ in. thick and 29¾ in. deep. The draw castings, of steel, are riveted in place between the center sills and back of the bumpers, and are arranged to take long-shank radial couplers of the M. C. B. type. The bolster plates, over the trucks, are 66 inches wide, and are substantially braced to provide the necessary stiffness.

This locomotive is fitted with air sanders, having spouts to all the wheels; combined air and hand brakes; two air whistles, and two electric headlights. The principal dimensions are as follows:

Truck wheel-base	7 ft. 4 in.
Total wheel-base	25 ft.
Distance between truck centers	17 ft. 8 in.
Driving wheels, outside diameter	42 in.
Width over all	10 ft.
Height to top of cab	12 ft.
Actual total weight	98,100 lbs.
Estimated weight of mechanical equipment	57,000 lbs.

For propulsion, there are four Westinghouse 120 H. P., 600-1200 volt commutating-pole railway motors, with a gear ratio of 19 to 54. This motor is of the slow speed type and particularly adapted to freight haulage.

Direct Current Freight Locomotive—Oakland, Antioch & Eastern Railway.

The HL unit switch type of control is used. The motors are connected in series and parallel with each other in conjunction with the necessary resistance to produce smooth acceleration on either 600 or 1200 volts operation. A hand-operated change over switch is used to change the main circuit from 600 to 1200 volts or vice versa. On 1200 volts the motors are operated four in series and four in series parallel. On 600 volts they are connected for operation with four in series parallel and four in parallel. A motor-generator furnishes low voltage for supplying the lighting and control circuits.

This locomotive will exert a tractive effort of 16,700 lbs. at approximately 10.65 m.p.h., and with a clean dry rail, a maximum tractive effort of 23,500 pounds as possible with this locomotive.

M. M. AND M. C. B. PAST PRESIDENTS.

M. M. ASSOCIATION.

H. M. Britton	1868-1876
N. E. Chapman	1876-1880
J. N. Lauder	1880-1882
Reuben Wells	1882-1884
John H. Flynn	1884-1885
J. Davis Barnett	1884-1885
J. Davis Barnett	1885-1886
William Woodcock	1886-1887
Jacob Johann	1886-1887
J. H. Setchel	1887-1889
R. H. Briggs	1889-1890
John MacKenzie	1890-1892
John Hickey	1892-1894
W. Garstang	1894-1895
R. C. Blackall	1895-1896
R. H. Soule	1896-1897
Pulaski Leeds	1897-1898
Robert Quayle	1898-1899
J. H. McConnell	1899-1900
W. S. Morris	1900-1901
A. M. Waitt	1901-1902
G. W. West	1902-1903
W. H. Lewis	1903-1904
P. H. Peck	1904-1905
H. F. Ball	1905-1906
J. F. Deems	1906-1907
William McIntosh	1907-1908
H. H. Vaughan	1908-1909
G. W. Wildin	1909-1910
C. E. Fuller	1910-1911

M. C. B. ASSOCIATION.

I. W. Van Houten	1867-68-69, 1873
F. D. Adams	1870-1871
M. C. Andrews	1872
Leander Garey	1874-1885
B. K. Verbryck	1885-1887
William McWood	1887-1890
Jno. Kirby	1891-1893
E. W. Grieves	1893-1895
J. S. Lentz	1895-1897
S. A. Crone	1897-1899
C. A. Schroyer	1899-1900
J. T. Chamberlain	1900-1901
J. J. Hennessey	1901-1902
J. W. Marden	1902-1903
F. W. Brazier	1903-1904
W. P. Appleyard	1904-1905
J. E. Buker	1905-1906
W. E. Fowler	1906-1907
G. N. Dow	1907-1908
R. F. McKenna	1908-1909
F. H. Clark	1909-1910
T. H. Curtis	1910-1911

There are requests from British interests in China for concessions to enable British interests to open connections with India and Burma and with India through Tibet. These connections would be of international importance. The engineering difficulties are said to be numerous and all but insurmountable. The connection from Szechwan province through Tibet is proposed with the idea that it can follow the caravan and trade routes from Chungking west to Batang south along the caravan routes now used to transport goods from India to Tibet. This caravan service connects with a special steamer sailing at stated periods from Glasgow, Scotland, with British goods for this trade. The light railway from Bahmo to Tengyueh is a portion of this transportation system. The Tibet route seems to be offered as an alternative route to the connection between Tengyueh and Yunnan.

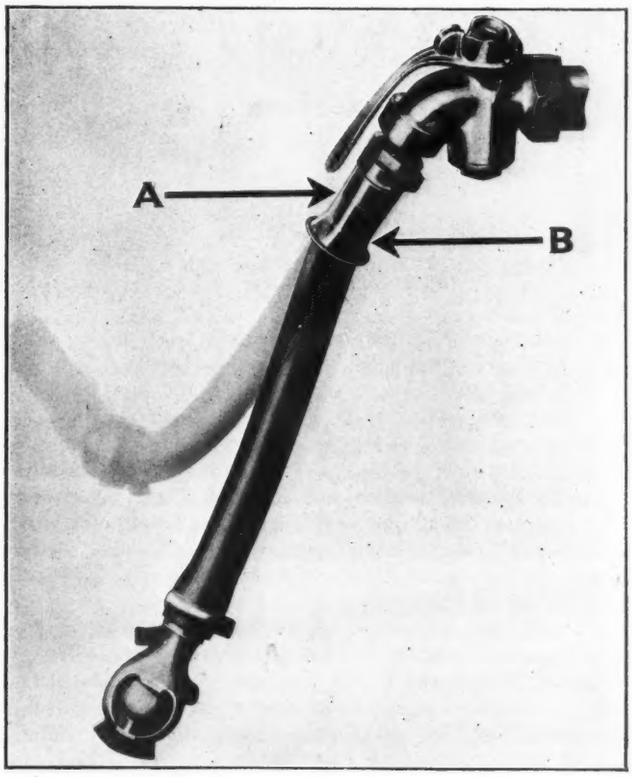
The Exhibit.

INDIRECT LIGHTING WITH THE PINTSCH MANTLE.

One of the serious objections to indirect lighting is the fact that approximately 50 per cent. of the initial candle power of the fixture is absorbed by this method. This objection is serious when considered in connection with electric lighting of railway cars, since all of the available wattage is needed to supply sufficient illumination by the old direct lighting method. The Pintsch mantle, however, has a higher initial candle power, and for that reason should prove efficient in connection with indirect lighting. To those who prefer this method of illumination to the direct system, any arrangement whereby the Pintsch mantle can be successfully employed indirectly, should be a welcome addition to the field of railway car illumination. The Safety Car Heating & Lighting Company, New York, has been conducting extensive tests and experiments along this line, and have announced their success in developing an indirect lighting fixture for use with the Pintsch mantle. This company had expected to be in a position to exhibit one of these fixtures at Atlantic City, but one or two unforeseen defects had to be remedied, which delayed the final completion of the fixture. Whether or not indirect lighting for railway cars will continue to be used, it is interesting to know of the final success of this Pintsch mantle indirect lighting fixture.

AIR HOSE PROTECTOR.

The illustration shows the application of the Universal air hose protector, made by the McCord Manufacturing Company, Chicago, Ill., which is designed to especially protect the hose from damage at the end of the nipple. *A* indicates the lower end of the air hose nipple. It is at this point that a very large percentage of air hose fails, caused by injury to, and the perforation of, the inner tube, as



Air Hose Protector.

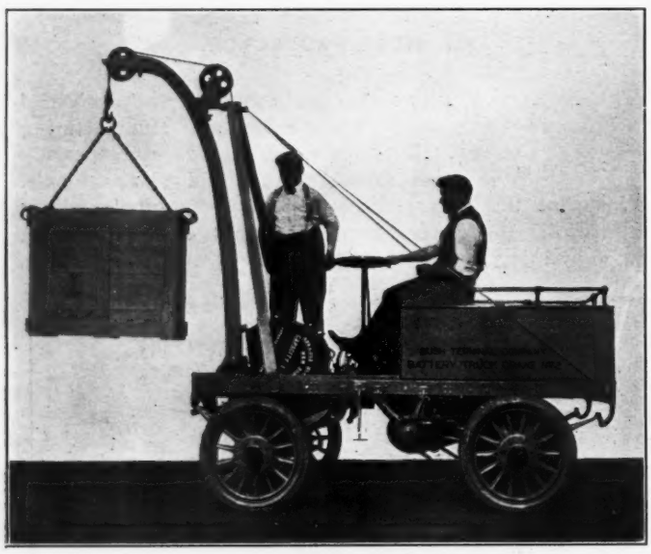
well as, in many cases, by being injured on the outside. In the latter case, the action of the elements on the bruised outer portions deteriorates the whole structure of the hose. The Universal air hose protector is a rigid section, formed with a bell-shape at the lower end, effectively supporting the hose at the required distance below the nipple end, properly protecting and relieving the usual strain.

Examination of condemned hose shows the tube to be in perfect condition from a point indicated by arrow *B* down to the coupling. This protector shields and protects all the portion of the hose above arrow *B*, entirely relieving the strains and resultant deteriorating effects, prolonging the life of the hose equal to that of the lower portion. Several thousands of these protectors are in use with satisfactory results.

BATTERY TRUCK CRANE.

The battery truck crane is designed for service in railway shops, freight houses, warehouses, terminals and docks, in short, anywhere where cars or lighters are loaded and unloaded; where packages weighing less than one ton are moved less than 400 feet; or where a number of heavy packages are moved over a greater distance. As an instance of their value, it is estimated that these machines earn each year 288 per cent. of their first cost at the Bush Terminal Company, New York.

For loading and unloading cars, the machine is brought to an advantageous position, the brakes are set and the hoist is



Battery Truck Crane.

put in operation. The limiting arc of the boom is 180 deg., and the maximum weight that the crane can handle is one ton. In one instance 360 castings, aggregating 65,000 lbs., were unloaded from a gondola car in five hours, an average of 1.2 lifts per minute, the speed being limited only by the rapidity with which two men could attach the slings to the castings. In another instance, a box car was loaded with sixty-four 800-lb. barrels of plumbago in 25 minutes, and four cars were loaded in 2½ hours, including spotting cars. This work averaged two barrels per minute, hoisted nearly 5 ft. and swung inside the cars.

When packages are moved in small quantities over a distance of less than 400 ft. they are attached to the hook, raised and carried to their destination. By this method sixty 800-lb. barrels of plumbago were moved 300 ft. in one hour with the assistance of only one helper. At another time one hundred and fifty 300-lb. boxes of rubber were loaded into a box car 75 ft. away in 50 minutes; three boxes were slung together and a round trip was made every minute. In a storeroom, boxes of angle and flat iron, weighing 10,000 lbs. each, were carried 30 ft. and stacked at the rate of 40 boxes an hour.

The machine has proven most economical in transferring large quantities of miscellaneous package freight over distances greater than 400 ft. In this class of service trains of about four trailers are attached to the battery truck crane, three trains of trailers being assigned to one battery truck, one train at loading point, another en route and the third being unloaded at the destination. Horses are used to make up the trains and to spot the trailers, and the men at each end are kept constantly busy. An average of 30 tons of freight an hour can be moved one-half mile by this method. The maximum load per train is six tons. In one instance, 600,000 lbs. of cotton were carried one-half mile in ten hours at the rate of twenty-four 500-lb. bales per load and a round trip every 12 minutes, an average of 1,000 lbs. per minute. On small package freight, using two trailers to the train, one battery truck crane moved 1,000,000 lbs. 600 ft. in 19 hours.

The machine consists of a short, heavy storage battery vehicle, having a swinging crane mounted on its forward end. The crane hook is raised and lowered by a hoist operated from the battery. It has a maximum drawbar pull of 2,000 lbs. The speed is nine miles an hour with a light load, seven miles an hour with one ton on the hook, and five miles an hour with five tons on trailers. The gage is 60-in. and the wheel base is 64 in., which permits the machine to make sharp turns. The weight is 5,000 lbs. The General Electric Company's universal type of automobile motor is used. The torque increases in direct proportion to the current increase without causing a material decrease in efficiency when the motor is exerting extra power. Continuous torque control is the characteristic feature of the controller, which assures starting and acceleration by gradual easy steps and eliminates the jerky movements which are detrimental to the transmission. The hoist has a maximum lifting capacity of one ton 20 ft. per minute with the pulley and double cable, or 40 ft. per minute with the single cable. The hoist is entirely enclosed and weatherproof. The drum has a winding capacity of 35 ft. of cable. The charging of the batteries may be tended by a watchman during the night. The machine can negotiate steep grades and can travel easily over the roughest pavements. The upkeep is cheap and an operator can be made of a common truckman receiving 20 cents an hour.

The battery truck crane is made by the General Electric Company, Schenectady, N. Y.

GRINDING WHEEL RECORDS.

The Carborundum Company, Niagara Falls, N. Y., has recently collected some data concerning the uses of its Aloxite and carborundum wheels. The Aloxite wheels are used for grinding reamers, cutters and general high speed tools, while the carborundum wheels are used for heavier work, such as car wheels, etc. In one railway shop on a large Southern system the tool room foreman has used a 10-in. Aloxite wheel for over five months and in that time it has only lost 2 in. and has not been touched with a dresser. This wheel ground two 2¼ in. drills of mushet steel from the rough stock, losing only 3/16 of an inch. The drills were 26 in. long and were made in the blacksmith shop being twisted from plain stock. In this same shop a 12-in. Aloxite wheel cut a piece of 2¼ in. x ⅝ in., in 55 seconds.

It was also shown that in another shop, car wheels were ground for less than one cent apiece with carborundum wheels. The report submitted from this shop showed that 28 carborundum wheels ground 54,456 car wheels. In another shop one carborundum wheel is credited with 1,348 wheels before it wore out. The exhibit of the Carborundum Company is located in Machinery Hall, where their grinding wheels will be working under actual shop conditions. The exhibit is equipped with a universal grinder, a heavy floor grinder, a drill grinder and a cutting-off machine.